U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION, THOMAS F. HUNT, DIRECTOR; CHARLES F. SHAW, IN CHARGE SOIL SURVEY.

SOIL SURVEY OF THE VENTURA AREA, CALIFORNIA.

BY

J. W. NELSON, IN CHARGE, AND WALTER C. DEAN OF THE UNIVERSITY OF CALIFORNIA, AND A. E. KOCHER E. B. WATSON, AND E. J. CARPENTER OF THE U. S. DEPARTMENT OF AGRICULTURE.

MACY H. LAPHAM, INSPECTOR, WESTERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1917.]

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., March 29, 1919.

SIR: I have the honor to transmit herewith the manuscript report and map covering the survey of the Ventura Area, California, and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1917, as authorized by law. This work was done in cooperation with the University of California Agricultural Experiment Station.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.

Soil map, Ventura sheet, California.

SOIL SURVEY OF THE VENTURA AREA, CALIFORNIA.

By J. W. NELSON, In Charge, and WALTER C. DEAN, of the University of California, and A. E. KOCHER, E. B. WATSON, and E. J CARPENTER, of the U. S. Department of Agriculture.—Area Inspected by MACY H. LAPHAM.

DESCRIPTION OF THE AREA.

The Ventura Area lies along the coast in the southwestern part of California and includes most of the southern half of Ventura County and a small area in the western part of Los Angeles County. Its eastern boundary is about 40 miles northwest of Los Angeles. The Santa Barbara National Forest, lying in the foothills of the Topatopa Mountains, limits the area on the north, the Santa Susana Mountains and part of the Santa Monica Mountains form its eastern boundary, the Pacific Ocean marks its southern and southwestern boundaries, and the Santa Ynez Mountains, with the hills joining them, its western limit. It includes nearly all the agricultural land of Ventura County and covers about 1,200 square miles, or 768,000 acres. In the construction of the soil map United States Geological Survey topographic sheets were used as base maps, necessary revision in the culture being made during the progress of the survey.

FIG. 1.—Sketch map showing location of the Ventura area, California.

The area varies widely in surface features. It consists of a series of narrow valleys and broad alluvial fan deltas, with intervening hilly and mountainous areas ranging in elevation to more than 6,300 feet above sea level. The Topatopa and the Santa Ynez Mountains, entering the area for a few miles along its northern and western boundary, with the Santa Monica Mountains in the southeastern part and the Simi Hills and the Santa Susana Mountains along its eastern boundary, form an elevated barrier almost encircling the area on its landward side. Oak Ridge and South Mountain, with altitudes ranging up to 3,000 feet, lying entirely within the area, form a divide separating the Santa Clara River drainage from Arroyo Las Posas and the Simi and Las Posas Valleys. The Ojai

(Pl. I, fig. 1), Upper Ojai, and Santa Ana Valleys form an oblong basinlike depression in the northwestern part of the survey, surrounded by mountains and drained by the Ventura River and its tributaries. A series of broken hills and mountains lie between Ventura and the Ojai Valley and extend northeastward along the Santa Clara River Valley to the eastern boundary of the area. Except for the break formed by the Ojai Valley, they gradually merge into the mountains to the north. In addition, a number of irregular detached elevations occur north and northeast of Conejo Valley in the southeastern part of the survey, which, with the hilly and mountainous areas described above, cover about three-fourths of the total area mapped. The great alluvial delta, or fan, constituting the Oxnard Plains and formed mainly by the Santa Clara River, constitutes the most extensive nearly level surface in the area. A few other small valleys, such as the Conejo, Russell, and Potrero Valleys, are small basins in the hilly region just north of the Santa Monica Mountains. Plate I, figure 2, gives a view of the Potrero Valley.

The highest mountains are usually quite rough and rugged, while the hilly areas below 3,000 feet present smooth, rounded outlines, except over portons where erosion has been unusually active or where land slides are numerous. The northern slopes of Oak Ridge and the southern slopes of Sulphur Mountain are badly eroded and include many rough, broken, nearly precipitous surfaces. High alluvial terraces flank the larger streams in places, and terraces of marine origin occur near the ocean. The latter are usually much dissected, and in places only a fragmentary outline of their original surface remains.

Except for the southern slope of the Santa Monica Mountains and a small area on the east drained by the San Fernando Valley, the drainage of the area is generally in a southwesterly direction to the Pacific Ocean. The slope is gradual, and the major streams have insufficient fall through much of their courses to scour well-defined channels. The Santa Clara River with its main feeders, such as Santa Paula, Sespe, and Piru Creeks, forms the principal drainage system in the area. The major stream flows in a well-defined valley of the same name, ranging in width from about 3 miles in its lower part to about 1 mile where it enters the survey. This is the most important valley in the area. The Ventura River enters the area in the northwest and flows southward to the ocean at Ventura. It receives the drainage from the Ojai Valley through San Antonio Creek, and that from the Santa Ana Valley through Coyote Creek. These streams, with a number of others, drain the western part of the area. Arroyo Las Posas, entering the area east of Simi Valley, forms the chief drainageway for the central part. It drains a large territory, most of which lies within the survey, but it has no well-defined

channel and carries water only during very wet periods. It empties into the ocean through Calleguas Creek, near Mugu Point, and because of its choked channel sometimes causes damage to part of the Oxnard Plains by overflow. All parts of the area are supplied with drainage outlets adequate to carry the run-off except the Oxnard Plains and part of Simi Valley where a high water table exists. The larger streams rarely have banks more than 3 or 4 feet high and are depositing sediment along much of their courses in the area. The creeks and other small drainageways entering them have a much greater fall and in most places are still actively eroding their channels. Nearly all the streams are intermittent and afford no water power except in small amounts during part of the year along their upper courses.

The population of Ventura County, according to the census of 1910, is 18,347. The inhabitants live mainly in towns, but there is a large rural population in those sections in which intensive agriculture has been developed. The greatest density of population occurs along the lower course of the Ventura River and in the Santa Clara Valley from Ventura to Piru. Nearly all the people live in the valleys or along the small drainageways, the populated sections forming much less than half of the area. Most of the population is American, but there are also a large number of Mexicans and some Japanese. In 1910, 70 per cent of the population was classed as "rural."

Ventura is the county seat and the largest city of the area, with a population in 1910 of 2,945. It is located on the coast near the mouth of the Ventura River. Oxnard, 10 miles southeast of Ventura, is the second city in size, with 2,555 inhabitants in 1910. Santa Paula is the largest city in the Santa Clara Valley and had 2,216 people in 1910. Fillmore, Piru, Saticoy, Montalvo, Bardsdale, and Buckhorn are other cities and towns located along the Santa Clara Valley. Ojai is the principal town in the Ojai Valley. Somis, Moorpark, Simi, and Santa Susana are small towns located along the small valleys traversed by the Arroyo Las Posas, and Camarillo, Hueneme, and El Rio are situated on the Oxnard Plain. A number of other small stations occur along the railroads, but they are very small and unimportant.

The main coast line of the Southern Pacific Railroad enters the area east of Santa Susana, passes down Arroyo Las Posas to Camarillo, then west and northwest to Oxnard and Ventura, and up the coast to San Francisco. A branch follows up the Santa Clara Valley from Ventura to Saugus, where it connects with the main line north through the San Joaquin Valley. Another branch connects Ojai with Ventura. These lines place shipping facilities within easy reach of nearly all parts of the area.

A section of the State Highway passes through the area and connects it with Los Angeles. Similarly improved branch roads are being rapidly completed through Las Posas Valley and along Arroyo Las Posas. Another extends along the Santa Clara Valley, and one extends from Ventura to Ojai. Other roads in many places are kept in good condition, but in some districts they are not so good, owing partly to sandy soils and partly to heavy traffic.

Good schools, electricity for light and power, the telephone, and daily mails reach all the important farming communities and, with the other advantages mentioned, enable the people to enjoy most of the comforts of city life.

The area is primarily agricultural and does not offer inducements for manufacturing except to a few industries which depend upon agriculture for their raw material. Chief among these is the production of beet sugar, for which a large factory is located at Oxnard. Local demand absorbs but a very small proportion of the products grown in the area, but the nature of the crops allows a long period for their disposal, and markets for the surplus are readily found in other parts of the State and in States farther east.

CLIMATE.

The climate of the Ventura area is similar to that of other coast regions in Southern California. It is one of the important factors in the high degree of agricultural development attained, as well as in the types of agriculture practiced. The year is divided into a wet and a dry season, corresponding to winter and summer, respectively. The rainy period usually extends from November to May, inclusive, with most of the precipitation occurring during the three winter months. The rainfall varies from year to year and increases from the ocean northward to the Topatopa Mountains. The rains are usually gentle, but at times they are heavy, and when continued for several days they may result in greatly swollen streams and some local damage from floods. The higher valley slopes and steep mountainous areas lose much of their rainfall in the run-off, and their more exposed southern and western portions become dry and barren in appearance during the summer months. The eastern and northern slopes retain their moisture much longer and support a moderate to heavy growth of oak, native walnut, and brush. Unusually wet winters are accompanied by many landslides varying in extent and occurring almost entirely in old, elevated, unconsolidated deposits and in regions of feebly cemented shales and sandstones which are upturned at a steep angle in most places.

Very little or no rainfall occurs during the summer months, but the coastal portion of the area for a number of miles inland is influenced greatly by damp, cool ocean air and fogs during the grow-

ing season. This enables many of the crops to mature and produce abundantly without irrigation. As the distance inland increases, the cooling influence of the ocean becomes less marked, and with the increased summer temperature, irrigation becomes more necessary. Rainfall is well distributed over the area but varies somewhat locally, depending upon elevation and air currents.

Temperatures vary greatly in different parts of the area, being relatively low along the coast, with increasing heat and lower humidity inland. The temperature is also noticeably influenced by topography, wind movement, and exposure. The foothills and alluvial fan slopes are subject to the least extremes in temperature and are usually preferred for fruit growing. The more hardy vegetables thrive during the winter months in all parts of the area, and the more tender crops have about an eight or nine months' growing period. The warmest part of the year is from about June 15 to the last of September, and the greatest danger from freezes usually occurs in the three winter months.

The following tables give the rainfall and temperature records for Ventura, Oxnard, West Saticoy, and the Ojai Valley within the area, and Newhall, a short distance outside area, and Newhall, a short distance outside the survey to the west and east, respectively.

Normal monthly, seasonal, and annual temperature and precipitation at Ventura.

Length of record—36 years. Elevation—50 feet.

Month.	Temperature (mean).	Precipitation.		
		Mean.	Total amount for the dryest year (1898).	Total amount for the wettest year (1884).
	°F.	*Inches.*	*Inches.*	*Inches.*
December	54.9	2.37	0.16	4.95
January	52.8	4.03	1.54	7.38
February	53.2	3.36	.74	9.96
Winter	53.6	9.76	2.44	22.29
March	53.6	2.86	.68	9.44
April	56.0	.73	.00	2.06
May	58.6	.34	1.40	.13
Spring	56.1	3.93	2.08	11.63

Normal monthly, seasonal, and annual temperature and precipitation at Ventura—Con.

Month.	Temperature (mean).	Precipitation.		
		Mean.	Total amount for the dryest year (1898).	Total amount for the wettest year (1884).
	°F.	*Inches.*	*Inches.*	*Inches.*
June	62.1	.07	.00	1.70
July	63.5	.01	T.	.00
August	64.6	.01	.00	.00
Summer	63.4	.09	.00	1.70
September	61.4	.25	1.10	.00
October	60.1	.71	.12	.38
November	57.2	1.28	T.	.84
Fall	59.1	2.24	1.22	1.22
Year	58.2	16.02	5.74	36.84

Normal monthly, seasonal, and annual precipitation at West Saticoy.

Length of record—25 years. Elevation—150 feet.

Month.	Precipitation.		
	Mean.	Total amount for the dryest year (1900).	Total amount for the wettest year (1909).
	Inches.	*Inches.*	*Inches.*
December	2.08	0.00	9.31
January	3.96	2.25	10.06
February	2.44	.00	5.74
Winter	8.48	2.25	25.11
March	3.09	1.10	4.70
April	.44	.15	.00
May	.43	.31	.00
Spring	3.96	1.56	4.70
June	T.	.00	T.
July	.01	.00	.00
August	T.	.00	.00
Summer	.01	.00	T.
September	.48	T.	.00
October	.79	.25	.48
November	1.03	3.73	1.45
Fall	2.30	3.98	1.93
Year	14.75	7.79	31.74

Temperature data from Oxnard, Calif.

	1909	1910	1911	1912	1913	1914	1915	1916	Average.
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
January	55.0	51.4	54.8	55.4	50.4	55.7	55.6	50.6	53.6
February	56.1	55.8	51.0	56.6	53.5	57.5	54.5	57.3	55.3
March	55.1	56.9	58.0	53.6	56.9	62.4	60.0	59.6	57.8
April	58.7	60.9	57.8	55.4	56.8	60.6	59.3	61.5	58.9
May	58.0	59.0	59.7	61.2	59.3	59.8	60.5	58.9	59.5
June	58.6	60.4	61.4	62.0	63.4	62.3	62.5	60.6	61.4
July	63.4	66.1	64.8	63.2	69.8	63.5	65.8	63.5	65.0
August	62.8	64.3	64.5	64.4	67.5	65.8	67.9	67.1	65.5
September	65.6	65.8	63.6	63.8	67.7	63.6	64.1	60.9	64.4
October	63.6	64.2	62.8	64.2	66.8	65.7	59.8	58.2	63.2
November	56.2	59.5	62.1	60.3	59.9	63.1	61.0	57.5	59.9
December	52.8	56.4	52.9	54.6	54.5	53.7	56.1	51.1	54.0
Average									59.9

Normal monthly, seasonal, and annual temperature and precipitation at Ojai Valley.

Length of record—6 years. Elevation—900 feet.

Month.	Temperature (mean).	Precipitation.		
		Mean.	Total amount for the dryest year (1908).	Total amount for the wettest year (1909).
	°F.	Inches.	Inches.	Inches.
December	51.9	3.63	1.33	12.28
January	51.6	7.94	6.49	10.75
February	53.0	3.34	5.98	8.27
Winter	52.2	14.91	13.80	31.30
March	54.7	6.63	.27	5.52
April	57.5	.66	.63	.07
May	59.5	.78	.31	T.
Spring	57.2	8.08	1.21	5.59
June	65.0	.05	.00	.10
July	71.2	T.	T.	.00
August	71.1	T.	T.	.00
Summer	69.1	.05	T.	.10
September	68.5	.86	1.47	.05
October	64.3	.83	.24	.98
November	58.3	.67	1.49	1.10
Fall	63.7	2.36	3.20	2.13
Year	60.5	25.40	18.21	39.12

Normal monthly, seasonal, and annual temperature and precipitation at Newhall, Los Angeles County.

Length of record—37 years. Elevation—1,200 feet.

Month.	Temperature (mean).	Precipitation.		
		Mean.	Total amount for the dyrest year (1877).	Total amount for the wettest year (1889).
	°F.	*Inches.*	*Inches.*	*Inches.*
December	49.5	3.13	1.45	15.70
January	47.9	2.93	1.56	.35
February	50.2	3.28	T.	1.11
Winter	49.2	9.34	3.01	17.16
March	54.1	3.37	.43	9.39
April	58.9	1.04	.50	.40
May	64.1	.54	.56	.56
Spring	59.0	4.95	1.49	10.35
June	70.7	.07	.00	.00
July	76.6	.00	.00	.00
August	77.3	.03	.00	.36
Summer	74.8	.10	.00	.36
September	71.5	.40	.00	.00
October	62.1	.73	.03	8.19
November	54.8	1.37	.32	3.36
Fall	62.8	2.50	.35	11.55
Year	61.5	16.89	4.85	39.42

The average date for the last killing frost in spring at Newhall is March 19; that for the earliest in fall, November 14; while the actual latest killing frost in spring is April 29 and the earliest in fall, October 3. The latest average date for Santa Barbara in spring is January 19, and the earliest average for fall is December 13; while the latest killing frost in spring is March 18, and the earliest in fall is November 28.

Much foggy and cloudy weather occur during the winter months, the lower portions of the area and those nearest the ocean usually being most affected. Fog also continues intermittently through the spring and summer months, but generally does not extend as far inland as in winter. It has a marked influence on the crops and practically marks the limits of profitable lima-bean and walnut production.

Wind movement is principally from the west and southwest, and is most marked during the winter and spring months. Eucalyptus windbreaks have proved of great value in areas near the coast in protecting crops and preventing serious drifting of the light-textured

soils. The late summer and fall months generally have the greatest proportion of sunshine.

The area is generally known to be favorable climatically to a wide range of fruits and other intensive crops. It is also considered healthful and is sought by many people during the summer for relief from the intense heat of the inland valleys.

AGRICULTURE.

Agriculture in the Ventura Area dates back to about 1782, with the coming of the mission fathers. For many years after this very little farming was done, and the cattle and sheep industries occupied the attention of the settlers. Many large Mexican land grants were made at an early date, but active farming was not begun until about fifty years ago. At this time several of the large holdings were subdivided and sold to settlers, who began the growing of wheat, barley, and corn. Following this, new crops were gradually introduced, which with more intensive farm practices slowly displaced the hitherto prevailing extensive systems, until the present state of development was attained. According to the census the size of farms decreased from 584.1 acres in 1880 to 425.5 acres in 1910. During this period the percentage of owners operating their own farms increased from 60.6 to 69.2. The large acreages devoted to corn, wheat, and barley have fallen off, until the first two named occur now only in small patches scattered over the area. The acreage of grain hay has increased quite rapidly, until in 1910 49,044 acres were devoted to this crop. The growing of apples and peaches has increased slowly but is still of very minor importance. The slow growth is due mainly to the fact that other crops are more profitable. Beans—principally limas—sugar beets, walnuts, apricots, lemons, and oranges are now the principal intensive crops grown. Alfalfa and potatoes are grown in a very limited way, and their acreage has not increased much in recent years.

The orchard industry is very important and is most intensively developed in the region from Santa Paula to Ventura and for several miles up the Ventura River. Other important fruit-producing sections lie around Fillmore, Bardsdale, Piru, and in the eastern part of Ojai and over most of the Little Ojai Valleys. Others are around Moorpark and in the Santa Ana, Santa Rosa, and Simi Valleys. These parts of the area have proved unusually well adapted to fruit growing because of the favorable soil, drainage, and climatic conditions. The production of beans so far as acreage is concerned, is the leading agricultural industry in the area, with centers in Las Posas and Pleasant Valleys and very extensive plantings extending east to Moorpark, and in the regions around Oxnard and Ventura.

Simi Valley and other portions of the area also have considerable areas devoted to this crop. The sugar-beet industry is centered on the Santa Clara River delta around Oxnard and to the east. Barley, the other extensively-planted field crop, is widely grown, but is a more important crop in the Conejo Valley and the region to the northeast than elsewhere. It is the main crop in the hilly areas and on soils less well adapted to more intensive crops. Each of the leading agricultural industries has developed on soils and in climatic zones apparently best suited to the particular crops grown and the system followed, and dry farming is the rule, except in growing citrus fruits and walnuts and certain of the other crops in unfavorable years.

Beans.—According to the report of the State horticultural commission for 1916, the production of beans in Ventura County in that year amounted to 60,100 tons, the area in lima beans alone amounting to 75,000 acres. Beans are grown on a wide range of soils but are sensitive to poor drainage and alkali conditions, especially if the salts or water table are within 3 feet of the surface. The heavy-textured soils are not so well adapted to their growth and give lower yields than the fine sandy loams, loams, silt loams, and silty clay loams of the recent alluvial series. For best returns, beans require a soil of medium to light texture, friable to the depth of 3 or 4 feet, and retentive of moisture. They generally mature earlier on such soils, which is an advantage in the curing and harvesting of the crop.

The growing of lima beans is confined to areas near the coast where fogs occur and where the humidity is ordinarily high. As the distance inland increases the lima is gradually displaced by the Black-eye, Pink, Lady Washington, and other varieties which thrive in drier and warmer climates. Beans are produced mainly under dry-farming methods, and as a result, proper preparation of the soil, weed control, and conservation of moisture are essential for success. The land is plowed in the fall and, following the winter rains, is cultivated a number of times to conserve moisture and kill the weeds. Planting is done when temperature conditions are most favorable for rapid growth, usually during the latter part of April and through most of May. The crop matures from the latter part of August until late in September and is harvested and thrashed by machinery. Beans do not exhaust the soil and in some places have been grown continuously on the same soil for 20 years or more, but the best opinion does not support this practice, on account of the danger of increase in fungous diseases and insect pests. The crop is used extensively for interplanting in young orchards and often pays all the costs of upkeep. Yields vary in different years and on different soils and with the cultural methods. They range from 20 to 30 sacks or more, of 80 pounds each, per acre for the

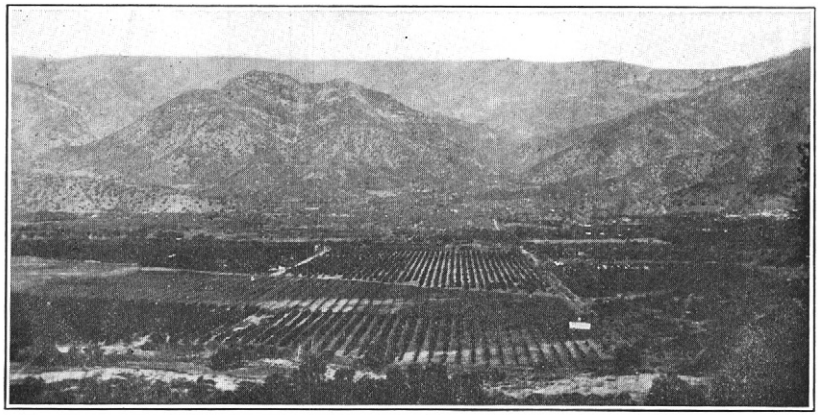

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FIG. 1.—OVERLOOKING OJAI VALLEY.

The cultivated lands occupy an alluvial fan comprising soils of the Yolo series. The orchards are mainly of citrus fruits.

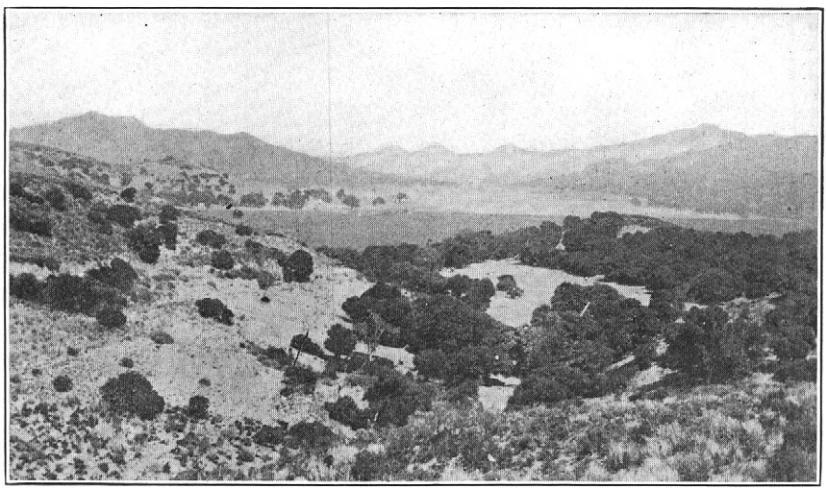

FIG. 2.—VIEW OF POTRERO VALLEY AND THE INCLOSING HILLS.

This valley is similar to many small basinlike valleys within the mountainous part of the survey. The hills are occupied by Rough broken and stony land.

best lands in favorable years down to a few sacks per acre under the least favorable conditions.

Sugar beets.—The first sugar beets grown in the area were produced during the season of 1898, the crop being shipped to the sugar factory at Chino. The factory at Oxnard was built in time for the crop of 1899. This factory is very large, having a capacity of 3,000 tons of beets a day.

In 1917 the area planted to sugar beets in Ventura County was 15,428 acres. The average yield of beets for the last five years has been 9.2 tons per acre, and the average sugar content 20.6 per cent. Very little of the area in beets is irrigated, probably not more than 500 or 600 acres. The rest of the crop is grown under ordinary dry-farming methods. Fertilizers are not used, but growers have recently begun to realize the necessity of some plan of crop rotation, as the yields have been declining. The crop is now rotated with lima beans, barley, or summer fallow, beans being preferred for this purpose.

The winter climate favors the continuous growth of beets, which makes possible a long planting season. Planting begins in November or December and continues until about the last of April. The early-planted beets sometimes send up seed stalks, and while the percentage of sugar in these beets is generally satisfactory, they are generally woody and are milled with difficulty. No attempt is made to produce beet seed commercially at Oxnard, but some experimental patches have produced good results.

The average cost of raising an acre of sugar beets in this county has been estimated to be $35 to $40. The labor employed is Japanese, Mexican, and Hindu. No serious difficulty has been experienced in getting labor.

For economic reasons sugar beets are not grown over much of the better soils of the area. It is found more profitable, under present high prices, to put such lands into beans. The beets are grown almost entirely on the lands of less well-developed drainage and moderate alkali content, where beans do not do well.

For the growing of sugar beets the Yolo very fine sandy loam is considered the best soil, with the Yolo fine sandy loam practically as good. The lighter members of the Yolo series, the sandy loam and fine sand, will grow a fair crop of beets, but these soils are not as durable. The Yolo silt loam and the Dublin loam are very good beet soils, but the soils of heavier texture, such as the clay loams and silty clay loams, are decidedly inferior. One of the main troubles with the crop on heavier soils is the difficulty of digging.

It is reported that after growing a few crops of beets a soil containing moderate quantities of alkali will give a good crop of beans, where before it was not possible to grow the crop successfully. It has been noted that in many places in the area alkali in high con-

centrations exists at 4 to 6 feet below the surface, while the surface itself is nearly free from injurious amounts of salts. It is probable that the culture given the beets aids in moving the alkali to lower depths, and this puts the soil in condition to grow beans.

The wild morning-glory, that is so troublesome in bean fields, does not seriously infest the soils where sugar beets are grown. The sugar-beet nematode is troublesome, but can be controlled by rotation.

The beet pulp produced at the factory is dried and sold for stock feed. About a quarter of the output has waste molasses consisting of nearly one-half sugar added to it. This makes it a more palatable and nutritious feed for the stock.

Walnuts.—The report of the State commission of horticulture for 1917 gives the number of bearing walnut trees in Ventura County as 174,544 and of nonbearing trees as 43,458. The largest orchards are between Ventura and Santa Paula, and important districts also occur in the vicinity of Moorpark, Simi, and Santa Susana. From Santa Paula eastward, including the Fillmore, Bardsdale, and Piru country, there are scattered orchards. Some walnuts are also grown in the lower Ventura Valley and around Oxnard and Camarillo. A few small plantings occur elsewhere in the area. More than 95 per cent of the walnuts are grown on the soils of the Yolo series, mainly on the silt loam, fine sandy loam, and loam types, though the other types of this series are also utilized. Deep, friable, well-drained soils free from alkali appear to be best adapted to walnuts.

The amount of irrigation necessary depends upon the soil, exposure, distribution of rain, atmospheric humidity, winds, and temperature. The majority of growers irrigate twice, the first application usually being made in April or May and the second in August or September. A few do not irrigate at all and some only once, just before the nuts drop. Young orchards are sometimes left dependent on the rainfall for their moisture supply. Intercropping is quite a common practice in young orchards, and irrigation then becomes more necessary. No fertilization is practiced, and only a few of the more progressive growers plant cover crops.

Yields average about 1,000 pounds per acre from mature trees and sometimes reach 2,000 pounds or more. The crop is handled mainly through the local branches of the State Walnut Growers' Exchange, and choice nuts bring the producer from 12 to 14 cents a pound.

Placentia (*Placentia Perfection*) is the leading variety in most of the new plantings, although a few Franquettes are being grown around Santa Susana and in the Santa Ana Valley. The old orchards are almost entirely of the Santa Barbara Soft Shell seedling type.

Blight is the worst disease attacking the walnut, and no successful control has been worked out to date. Melaxuma is sometimes

very serious, and aphids cause trouble in unfavorable weather. A few other minor diseases and troubles are also present.

Ventura County produced 5,133 tons of walnuts in 1916, but extension of the industry appears rather doubtful because of high prices of land, the slow maturing of the trees, and because of other more profitable crops which may be grown.

Apricots.—Apricots constitute the most widely distributed fruit crop in the area. Orchards have been established in the Ventura River, Santa Ana, Ojai, and Upper Ojai Valleys; in the Santa Clara River Valley as far west as Saticoy and including the smaller tributary valleys to the north; and in the district around Moorpark, Simi, and Santa Susana. The report of the State horticultural commission for 1917 shows 274,938 bearing and 298,143 nonbearing trees in the county. Apricots thrive on a wide range of soils, but are confined mainly to types derived from recent alluvial and old valley-filling materials.

Only about 25 to 30 per cent of the apricot orchards are irrigated, cover crops are not grown, and commercial fertilizers are not used to any extent. A few orchardists apply stable manure. One ton of dried fruit to the acre is considered a good yield. This is equivalent to 4 or 5 tons of green fruit. Nearly all the fruit is dried, normally only about 10 per cent being sold fresh for consumption or for canning. In 1916 the county produced 2,700 tons of dried apricots and 1,074 tons of green fruit.

About 95 per cent of the apricots in the area are of the Royal variety. This is a very regular bearer, while most of the other varieties commonly grown are not, though the Tilton has proved fairly successful. Spraying is commonly practiced every other year for black and brown apricot scale and other troubles. Crown gall and oak fungus are sometimes serious.

The future of the industry is quite promising. There are more nonbearing than bearing trees in the county, and the soil and climatic factors seem to be favorable. The prices received are usually good.

Lemons.—The main lemon plantings are located in the narrower part of the Santa Clara Valley from a point north of Saticoy to 4 miles east of Piru, and in the lower valley of the Ventura River. Scattered plantings also occur in the Ojai Valley and on the broader, more level plains of the Santa Clara River east and southeast of Ventura and in the district around Oxnard and eastward to Camarillo. Minor plantings occur elsewhere throughout the area, including one large acreage 2 miles northwest of Santa Susana. The 1917 report of the State commission of horticulture credits to Ventura County 209,433 bearing and 358,240 nonbearing trees. In 1918

there were 2,327 acres bearing and 3,980 acres nonbearing lemons. Because of danger from frost, most of the trees are on sloping or slightly elevated land. The principal soils used for the production of this fruit are the several types of the Yolo series, ranging in texture from gravelly fine sandy loam to silt loam. There is also quite an acreage on the Rincon loam and a few plantings on the Ojai very fine sandy loam and Pleasanton gravelly loam, with one or two on other types. The lemon will not tolerate alkali and requires a deep, well-drained soil for its best development, although it is not quite so exacting as the walnut in the latter respect.

The amount of irrigation required for lemons depends upon the soil, subsoil, temperature, winds, and the distribution and amount of rainfall. Water is usually applied from four to eight times during summer by the furrow method. The main irrigation season is from March to October, but the rule is to irrigate whenever necessary. On the Limoneira Ranch near Santa Paula, with a total of 850 acres of lemons, the water applied usually totals 20 to 30 acre-inches per year. Intercropping is sometimes practiced in young orchards, beans usually being grown, in which case a more abundant use of water is necessary. Orchard heating to prevent frost is generally practiced and materially raises the cost of production.

Commercial fertilizers, stable manure, and cover crops are used very extensively. The kinds and quantities of commercial fertilizer which will produce the best results have not been accurately determined. The plowing under of barnyard manure, bean straw, and cover crops is of undoubted value, through the increase of nitrogen and organic matter.

During the season of 1916, 1,321 cars of lemons were shipped out of the county. For the period 1910 to 1916, the yield has averaged about 250 packed boxes per acre.

Lisbon and Eureka are the main varieties grown. Mealy bug, black scale, and the common decays which develop in the packing houses are among the troubles which must be combated. The industry is highly specialized and is well developed in the county. Many new plantings are just coming into bearing, and the output will undoubtedly increase from year to year.

Oranges.—According to the report of the State commission of horticulture for 1917, there are 183,591 bearing and 144,200 nonbearing orange trees in Ventura County. The main plantings occur in the Santa Clara Valley from a point northeast of Montalvo to within 2 miles of the Los Angeles county line. The center of this district is at Fillmore and Bardsdale. A considerable acreage in the Ojai Valley is also devoted to this crop, and there are small plantings elsewhere in the area. Oranges are only slightly less susceptible to frost than lemons, and similar precautions are taken to safeguard the trees and the crop. Most of the orange orchards are

on the Yolo soils, mainly the silt loam, fine sandy loam, loam, and gravelly fine sandy loam. The Pleasanton gravelly loam is used to some extent, and a few groves have been set on the Rincon loam. The orange requires about the same characteristics of soil as the lemon. The facts concerning irrigation, fertilization, and cover crops stated in the discussion of lemons apply equally well to the management of the orange.

During 1916 there were 1,465 carloads of oranges shipped out of Ventura County. The Washington Navel and Valencia are the leading varieties, the former representing the older plantings of the Ojai, Fillmore, and Bardsdale districts, and the latter most of the more recent plantings. Navel oranges are harvested from December to May and Valencias from May to August. The outlook for the industry is very favorable, although not so much so as for lemons, there being only about half as many nonbearing orange trees as nonbearing lemon trees in the county.

Miscellaneous fruits.—Olives, almonds, prunes, grapes, peaches, apples, pears, grapefruit, loquats, and avocados are grown in a limited way throughout the area. They appear to do well in favorable locations, but no large plantings of commercial importance have been made.

Grain and hay crops.—Barley is the leading grain and hay crop in the area. There were 59,121 acres planted to this crop in 1910, according to the census, of which 10,077 acres were matured for grain and the rest cut for hay. Except where grown in rotation with other crops, barley is usually produced on soils less desirable for other crops and in remote situations. In years of abundant rainfall and low hay prices much of the crop is left to mature grain, but in dry years, or when the cost of hay is high, most of it is cut for feed. It receives no irrigation. Much of the grain and hay is fed in the valleys and towns, the surplus being shipped to markets outside of the area. Yields vary greatly and depend upon the rainfall, type of soil, and care given the land. In addition to this, there are about 2,000 acres of alfalfa and small areas of cultivated and native grasses grown for hay. Alfalfa averages about 3½ tons per acre per season, and in favorable years and on good soils yields of 8 or 10 tons per acre are obtained.

Miscellaneous field and truck crops.—Most of the corn grown is for table use, and the acreage is small. Potatoes, vegetables, and berries are grown near towns for local consumption. Several hundred acres of flowers, mainly nasturtiums, are grown for seed, which is shipped to outside points.

Poultry and bee culture.—Poultry and bees are quite important, but are subsidiary interests in most places. In 1910 there were 23,714 colonies of bees in the county. Bees are confined principally

to the hilly parts of the area and along brushy streamways, and much of the honey is obtained from native plants. An annual yield of about 80 pounds of honey per hive is obtained, and the yearly income from this source is about $100,000. Foulbrood, which has been serious in recent years, is a considerable check on the industry. The value of poultry and eggs for 1910 was $124,710.

Live stock.—In 1910 there were 2,666 dairy cows on farms in Ventura County. Besides supplying home consumption, dairy products to the value of $97,762 were sold locally or shipped to outside markets. This is more than twice the amount for 1900. Beef cattle range in the hills and utilize the extensive areas of land unsuited to crops. Cattle do well, and those sold and slaughtered bring an annual income of about $750,000, which is about three times the income from this source in 1900. Some sheep are still raised in the more hilly and mountainous parts of the county, a part of the flocks being driven to the valleys in winter to consume the roughage on the farms. Eight thousand eight hundred and fifty were sold or slaughtered in 1910. Hogs are also of considerable importance and supply the market with about 6,000 animals yearly.

Most of the farmers in the area use modern machinery in their operations. This is especially true where intensive, high-priced crops are grown. Good tillage and rotation appear to be the only requirements for many of the crops grown, but commercial fertilizer in large quantities is used for citrus fruits. In 1910 the cost of fertilizers in the county amounted to $57,432, which is an increase of more than 60 per cent over the consumption of 1900. Horses, mules, and tractors are used for farm operations, the animals being better adapted to the hilly regions and for small farms and small orchards, especially where intercropping is practiced. Thorough tillage is the rule, and it is not unusual to plow 8 or 10 inches deep. This with excellent cultivation gives a system of handling the soil rarely excelled anywhere. The readily available lands of the county suitable for crops are practically all under tillage, but according to figures obtained from a crop map made of the area in 1917, there are still more than 50,000 acres, occurring in tracts of from 5 to 1,000 acres each and located principally in the hilly parts of the area surveyed, which are suitable for the growing of dry-farmed crops. Much of this land can be reached easily with little road building, and other parts not quite so accessible could be utilized with a reasonable outlay for roads. Much of the land, being covered with brush, would require clearing, and from some of it the large stones must be removed. There is considerable land, however, where practically no outlay for these purposes would be necessary. The soil is usually of sufficient depth for good root development and receives enough moisture each year, if conserved, to produce good crops. The land consists of the

smoother and more uniform parts of large tracts frequently held in single ownership for grazing. The bringing of such undeveloped land under tillage will add greatly to the agricultural wealth of the county.

SOILS.

The soils of the Ventura Area may be broadly separated into four groups—namely, (*a*) residual soils, or those derived from the disintegration and weathering of consolidated rocks in place; (*b*) old valley-filling and coastal-plains soils, consisting of elevated and weathered unconsolidated water-laid deposits; (*c*) recent-alluvial soils derived from sediments that have not undergone material changes or internal modification since their deposition, and which are still in process of formation; and (*d*) wind-laid soils, the last being confined to a very narrow belt of drifting sand dunes along the ocean front. Besides these soils, parts of the area are occupied by lands mainly nonagricultural, which are separated from the preceding groups on practical economic grounds rather than on characteristics of origin and mode of formation.

A striking characteristic of the soils of this region which lie near and slope toward the ocean is their relatively high content of organic matter as compared with soils of more inland and therefore less humid areas of the southern part of the State.

The first three groups comprise the soils of nearly all of the agricultural lands of the State, the residual soils predominating the mountainous regions, the old valley-filling and coastal-plains soils usually being most extensive at lower elevations and along the seacoast, and the recent-alluvial soils prevailing on the floors of most of the valleys. The residual soils, which are rather inextensive in this survey, occur principally in the eastern and southeastern parts. The old valley-filling soils are much more extensive than the residual soils, and the recent-alluvial deposits far exceed the combined area of the other two.

Each of the groups mentioned includes a number of soil series, and each series is represented by one or more soil types. A soil series consists of soil types which possess a number of common characteristics, such as color, origin, mode of formation, and subsoil and substratum features which distinguish them from the soils of other series. Type separations are based upon differences in texture. Soil types sometimes include phases, a phase representing a variation from the typical soil insufficient in degree to warrant the recognition of a distinct type. The character of this survey does not permit showing all the types and phases separately on the map when occurring in small areas, owing to the mixed occurrence of the soils, and some grouping of minor soil types and phases in representing them upon the soil map was necessary.

Four types of miscellaneous material are mapped; viz, (*a*) River-wash, (*b*) Rough broken and stony land, (*c*) Coastal beach and dunesand,[1] and (*d*) Tidal marsh. These are nonagricultural types and are used mainly for pasture purposes. Rough broken and stony land is very extensive in this survey, forming most of the rough mountainous portions. The other three types of miscellaneous material cover only a few square miles on the lower parts of the valley floors.

According to the classification outlined above, the soils of the area were grouped into 11 series, including 28 types, with a number of phases and 4 types of miscellaneous material.

The different groups and series are characterized by the following general features:

RESIDUAL SOILS.

The residual soils of the area are identified with hilly and mountainous regions and are formed from the weathering of rocks in place. They are associated with Rough broken and stony land in many places and have some rock outcrop locally. The surface configuration generally consists of rounded hills and ridges of moderate slope with minor included roughly broken areas too small to differentiate as Rough broken and stony land. The rocks giving rise to this group of soils vary widely but consist principally of sedimentary formations or shales, sandstones, and conglomerates, with some of basic igneous origin and some of metamorphic formation.

The sedimentary rocks form the mountains along the northern boundary of the area, with smaller areas in the southwestern part and in the eastern, southern, and western parts of the Santa Monica Mountains. The residual soils formed from these rocks are of the Altamont and the Diablo series, the former comprising more than 95 per cent of the total area of the two.

The soils of the Altamont series are residual from sandstones, shales, and conglomerates, with minor areas of metamorphosed shales and sandstones. They range in color from brown or light brown to dark brown, with local areas of grayish brown and slightly reddish brown. The darker colors are usually associated with the heavier types and are more pronounced when the soils are moist. The subsoils are usually somewhat lighter colored, being brown, light brown, reddish brown, or grayish brown. They are often heavier and more compact than the surface soils and rest upon bedrock at depths in most places less than 6 feet. Lime is present in the subsoil of most areas, but the content varies considerably and is not so large as in the Diablo soils. The series is moderately extensive in this survey

[1] Dunesand being here nonagricultural is considered with the miscellaneous soils. On the basis of origin it should be placed in the wind-laid group.

and is most prominent in the hilly and mountainous districts in the northern, eastern, and southeastern parts of the area. The surface is rolling, hilly, or mountainous, with small areas of rock outcrop in places. The soils are well to excessively drained, but are retentive of moisture where bedrock is not too near the surface. They differ from the associated Diablo series in color and in content of lime and organic matter. In their virgin state they support a scrubby growth of brush and some scattering oaks on northern and eastern slopes.

The series is represented in this survey by four types—a stony loam, loam, with a light-textured phase, clay loam, and clay adobe.

The Diablo series is residual from rocks similar to those forming the Altamont series but includes types of greater lime content. The soils are dark gray to black, with dark grayish brown or dark brownish gray variations. They are high in organic matter. The subsoil is lighter colored than the surface soil, being grayish brown, brown, or dark brown. In most places bedrock is encountered at depths less than 6 feet. Apparent lime concentrations occur in the lower subsoil in most places. The soils are retentive of moisture if well handled, but the heavier types crack and dry out badly when untilled. One type, a clay adobe, was mapped in this survey.

Basic igneous rocks are much less extensive in the survey than sedimentary rocks. They are most prominently developed in the hills and mountains surrounding the Conejo Valley and form a large part of the Santa Monica Mountains lying within this survey. They are hard and weather very slowly and give rise to shallower soils than the sedimentary rocks. Their resistant character and irregularity of weathering often result in areas of Rough broken and stony land on slopes and hills which would be tillable in areas of similar position underlain by sedimentary rocks. The tillable soils derived from these rocks were classified in the Olympic series.

The Olympic series includes soils of brown, dark-brown, or dark grayish brown color, relatively high in organic matter. They are frequently hard and compact, and the heavier types usually have an adobe structure. The subsoils in most places are lighter-colored than the surface soils, ranging from brown to light brown or light grayish brown. They are typically more compact and heavier than the surface material and rest on bedrock at depths usually less than 6 feet. The topography is hilly, rolling, or mountainous, but the contours are generally rounding. Local areas of loose rock fragments and some rock outcrop occur. The soils have good drainage. Two types, a loam and a clay adobe, with stony and light-textured phases were mapped.

OLD VALLEY-FILLING AND COASTAL-PLAIN SOILS.

The soils of the old valley-filling and coastal-plain group are derived from elevated, unconsolidated, water-laid deposits which have undergone marked changes since they were laid down. They vary widely in color, ranging in this survey from reddish brown to black. The organic-matter content is usually high in types of heavy texture but lower in those of light texture. The soils have a varied topography. They occur in very hilly or rolling areas, on smooth to eroded marine or stream terraces, or on sloping remnants of old alluvial fans that have either been elevated since their deposition or have been left in their present positions by the cutting of deeper stream channels or valleys through them. These soils usually are intermediate in elevation between the residual and recent alluvial soils. Unlike the latter, they are undergoing active erosion or are slowly being covered with recent alluvial material. Soils of five series belonging in this group are mapped—the Rincon, Pleasanton, Ojai, Madera, and Montezuma series.

The Rincon series of soils includes types with brown to dark-brown soils, with variations of grayish brown or slightly reddish brown color. They are more or less compact and locally contain waterworn gravel and rock fragments. The subsoils are brown to reddish brown, more compact and heavier in texture than the surface soils, with local tendencies toward hardpan. The substratum resembles the subsoil, but is usually not so red nor so heavy. The materials from which the series is derived come mainly from sedimentary rocks. The series is well drained, contains a moderate amount of organic matter, and occupies sloping to undulating, hilly, or dissected surfaces, with erosion active on the more elevated portions. The soils are differentiated from the Ojai series on the basis of difference in color and absence of the gravel substratum, from the Madera series because of absence of hardpan, from the Pleasanton series because of a gravelly substratum in the latter, and from the Montezuma series on a basis of color. Three types, a fine sandy loam, a loam, and a clay loam, with minor phases, were mapped in the Ventura survey.

The soils of the Pleasanton series are derived from unconsolidated water-laid deposits originating in a wide range of rocks. The soils are brown, with slightly reddish brown variations. The subsoils are usually light brown or reddish brown, are either heavier in texture or more compact than the surface material, and rest upon a gravelly substratum at varying depths, usually less than 6 feet. The topography is varied but usually rolling or hilly. The surface is generally smooth, and drainage is well developed. The series differs from the Rincon, Madera, and Montezuma series in having a gravelly substratum, and from the Ojai series in color. Three types, a gravelly

sandy loam, a gravelly loam, and a loam, were recognized in the Ventura survey.

The types of the Ojai series have pale-yellow to yellow soils, with light grayish yellow or light brownish yellow variations. The subsoil has similar, somewhat lighter, or more pronounced yellow color and is typically heavier or more compact than the soil. It is underlain by a porous substratum of stratified sediments consisting mainly of gravel. The materials giving these soils come originally for the most part from sedimentary and metamorphosed sedimentary rocks. They occupy old alluvial fans and stream and coastal terraces. Drainage is well developed, and subdrainage is somewhat excessive. The soil and subsoil materials are not characteristically calcareous. This series is distinguished from the related soils of the Pleasanton series by its yellow color. It is represented in this survey by a single soil type of very fine sandy loam texture.

The Madera series includes types with brown soils, underlain by a heavier textured brown or reddish brown subsoil which rests upon a brown hardpan at depths usually less than 6 feet. The hardpan is formed mainly by cementation of the subsoil material by iron solutions, but it may at times be somewhat calcareous. It varies from a few inches to several feet in thickness and is underlain by a permeable substratum usually resembling the subsoil in color and texture. The series is derived from sediments of mixed origin, but in this area mainly from sedimentary rocks. It occupies rolling, hilly, or gently sloping areas and in this survey in most places has a smooth surface. Drainage is good. The series is represented in this survey by one type, the sandy loam.

The soils of the Montezuma series are dark gray to black in color, in many places showing a marked brownish cast when dry. The subsoil is brown or dark grayish brown, and in many places is streaked with concentrations of lime, giving it a mottled appearance.

The materials have the same origin as those giving the Madera soils. The soils are high in organic matter and retentive of moisture. They occupy hilly, rolling, or eroded fanlike slopes and are being reduced in extent either by erosion or by deposition of recent alluvial deposits. The series is characterized by its dark color, high organic-matter content, and calcareous subsoil. One type, a clay adobe, is mapped.

RECENT-ALLUVIAL SOILS.

The recent-alluvial soils form by far the most extensive group of the area. They cover nearly all of the Santa Clara River fan on the plains in the region about Oxnard and occur also as river-bottom deposits and as numerous alluvial fans lying in the main stream valleys at the mouths of tributary creeks and drainage ways. In some of the smaller valleys no distinct bottom lands are present,

the entire valley having an irregular surface composed of the numerous small fans that enter from the side drainage ways. The soils vary widely in color and are formed from various materials washed from the areas of sandstone, shale, conglomerate, basic igneous rocks, old valley-filling deposits, and other rocks lying in the drainage basins of the present streams. They are usually well drained on the steeper slopes, but frequently have a high-water table and carry injurious quantities of alkali in their lowest positions along stream courses and on the large Santa Clara River fan. Stratified subsoils are common in the soils of this group, this characteristic being most marked in valley bottoms and on the broad, gently sloping fans.

The recent-alluvial soils are classified in 3 series, including 12 types. Those whose materials come originally from sedimentary rocks and old valley-filling deposits are placed in the Yolo and the Dublin series and those from deposits washed from areas of basic igenous rocks in the Vina series.

The surface soil of the types in the Yolo series is brown, with variations of dark brown and grayish brown. The subsoil is in most areas a lighter shade of brown, although it is not unusual for the soil to be uniform in color and texture to a depth of 6 feet or more. Poor drainage, alkali, and occasional lime concentrations in the subsoil occur in the lowest lying positions adjoining the soils of the Dublin series. These conditions are not typical, however, and are extreme. The series is very extensive and occupies the floors and slopes of stream valleys and alluvial fans. It covers most of the extensive Santa Clara River fan. Except for a few moderately to steeply sloping alluvial fans, the surface is gently sloping, uniform and smooth, and well suited to tillage. The soils are differentiated from those of the Dublin series on the basis of difference in color and in content of organic matter. They are in the main treeless, but support some willow along stream courses.

Nine types, which range in texture from sand to silty clay loam, are mapped in this series.

The soils of the Dublin series are similar in origin to the Yolo soils but differ in color, being dark gray, dark grayish brown or black, with a subsoil similar to the surface soil in color and texture, except where stratification occurs. Small to moderate quantities of lime exist in poorly drained areas, but the series is not typically calcareous. The content of organic matter is usually high. Both soil and subsoil are permeable and retentive of moisture. Drainage is poor in many places, and the water table is frequently encountered at depths less than 6 feet. The Dublin soils occupy a position slightly lower than the soils of the Yolo series. The surface is

uniformly smooth and gently sloping to nearly level. Seepage areas and alkali accumulations are common over much of the series.

Two types of this series, a loam and a clay loam, which includes an adobe phase, are mapped.

The materials giving the soils of the Vina series have been washed from areas of basic igneous rocks. The surface soils are brown to dark brown, the darker colors existing in the types of heavy textures. The color tends to become darker when the soils are moist, and sometimes a peculiar reddish or rusty-brown cast is present, similar to that of the same series in the Sacramento Valley. The soils are moderately high in organic matter and retentive of moisture. The subsoil in most places is lighter brown than the surface soil, but the colors may be similar. The subsoil is in many places stratified. The series is not extensive in this area, being confined to the Conejo Valley and drainage ways emanating from the basic igneous rocks in that locality. The soils have smooth, uniform surface features. They are well drained. One type, a fine sandy loam, including a heavy silty variation, represents this series of soils as mapped in this survey.

The following table gives the name and actual and relative extent of the several soil types mapped:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Rough broken and stony land	413,568	56.7	Montezuma clay adobe	6,144	0.8
Yolo fine sandy loam	52,096	7.1	Yolo fine sand	6,144	.8
Altamont loam	42,112	6.0	Yolo silty clay loam	5,760	.8
Light-textured phase	1,600		Rincon fine sandy loam	3,392	.7
Rincon loam	18,880	3.5	Coarse phase	1,536	
Silty phase	5,824		Vina fine sandy loam	4,544	.6
Calcareous phase	1,024		Altamont stony loam	4,416	.6
Yolo silt loam	24,064	3.3	Madera sandy loam	4,096	.6
Altamont clay loam	17,408	2.4	Dublin loam	3,904	.5
Yolo loam	16,320	2.2	Pleasanton loam	3,264	.5
Yolo sand	12,480	1.7	Coastal beach and dunesand	2,880	.4
Riverwash	12,096	1.7	Tidal marsh	2,176	.3
Yolo gravelly fine sandy loam	11,584	1.6	Pleasanton gravelly loam	1,984	.3
Yolo very fine sandy loam	9,408	1.3	Pleasanton gravelly sandy loam	1,664	.2
Rincon clay loam	7,936	1.1	Olympic clay adobe	896	.2
Yolo sandy loam	7,808	1.1	Light-textured phase	576	
Dublin clay loam	4,544	1.0	Altamont clay adobe	448	.1
Adobe phase	2,752		Diablo clay adobe	384	.1
Ojai very fine sandy loam	6,656	0.9			
Olympic loam	3,712	0.9	Total	728,960	
Stony phase	2,880				

DESCRIPTION OF SOIL TYPES.

ALTAMONT STONY LOAM.

The surface soil of the Altamont stony loam consists of a moderately friable grayish-brown to dark-brown loam, 12 to 36 inches deep, carrying on the surface and throughout the soil mass varying quantities of stone. The variation in stone content is wide, some areas being nearly stone-free and others approaching Rough broken and stony land in character, with many rock outcrops. The content of organic matter is low, and no concentrations of lime are apparent in the soil or subsoil.

At a depth of 1 to 4 feet the subsoil is often lighter colored and in places heavier textured than the surface soil, being a light-brown or yellowish-brown stony loam or stony clay loam. The bedrock shows only a narrow zone of weathering, passing quickly into unaltered material.

The type is distributed through the Santa Monica Mountains. Several bodies lie about 2 miles southeast of Round Mountain; another is situated a mile north of Dume Point; and others lie in the hills south of Tierra Rejada Valley. A large acreage occurs in the hills near the headwaters of Las Virgenes Creek, and other small bodies at various places in the mountains. The topography is hilly and the surface sloping to steeply sloping and, on account of the numerous rocks present, uneven. Drainage is excessive and erosion active.

The soil is residual and derived from sedimentary rocks, principally sandstones. The native vegetation is brush of various kinds and low scrubby trees, of which oaks and sumac form the larger part.

The Altamont stony loam is a soil of very low agricultural value, and little of it is cultivated at the present time. The greater part of it is used for pasture. It affords only indifferent grazing.

ALTAMONT LOAM.

The surface soil of the Altamont loam, where typical, consists of a brown to dark-brown, locally grayish-brown, friable loam, 8 to 15 inches deep. It is usually free from waterworn gravel, but sometimes contains small amounts of shale fragments on the steeper slopes and on the crests of hills. The subsoil is a little lighter in color than the surface soil, prevailingly yellowish-brown or grayish-brown to brown. The texture is about the same or a trifle heavier, but the more compact structure renders the penetration of roots and water somewhat difficult. Small calcareous concentrations are present in places, and an adobe structure exists here and there. From about 3 feet down the parent rock is encountered. It consists of the more

or less disintegrated shale, sandstone, and conglomerate. Occasionally the surface soil rests directly upon the bedrock, and outcrops occur in places. The type has a moderate content of organic matter and is retentive of moisture.

In addition to the texture variations covering small areas, to be expected in a soil derived from several kinds of rocks, there are included with the type as mapped a number of more important variations. One of these is encountered along the crest of Oak Ridge. Here on the northern and eastern slopes the soil is darker in color and heavier in texture than typical, and in numerous small areas resembles the Diablo clay adobe. These could not be shown satisfactorily on a map of the scale used in this survey.

Included also with the type as a variation are bodies of silty soil with a total area of several square miles. One fairly large area is 6 miles north of Ventura, and scattered bodies are on the southern slopes of Oak Ridge. This variation also occurs in a number of areas in the Simi Hills and, with the exception of the western part, in various places in the Santa Monica Mountains. The soil resembles the typical soil in all respects except in texture.

A gravelly loam variation is also included. One body of this kind is situated 2 miles north of Mugu Point, two small areas 4 miles northeast of Dume Point, and there is one fairly large and two small bodies 10 miles east of Newbury Park. Other small areas occur in various localities. Five miles north of Santa Susana there is one small and one moderately large body of gravelly loam of silty texture. These gravelly areas are indicated on the map by gravel symbols. The surface soil in these gravelly areas ranges from a brown to dark-brown gravelly loam to gravelly silt loam. The gravel consists of angular shale fragments. The structure is loose and open, and the content of organic matter is rather low. The surface soil in most places rests directly on bedrock at depths not exceeding 36 inches. This variation is droughty, and dry farming is uncertain.

The Altamont loam is the most extensive residual soil in the area. Small bodies are scattered throughout the hills and mountains on the west side of the Ventura River from a point 1½ miles north of Ventura to and including the hills surrounding the Santa Ana Valley. The type is also mapped in the hills around the Ojai and Upper Ojai Valleys and on Sulphur Mountain. One small body lies 5 miles north of Saticoy and four small areas 5 miles northeast of Santa Paula. Scattered bodies occur in the hills north of the Santa Clara River from Sespe Creek to the eastern boundary of the area, and also on South Mountain and Oak Ridge. Areas likewise occur on the gentler slopes of the Santa Monica Mountains

and to the north towards Arroyo Las Posas and throughout the Simi Hills.

The surface of this soil varies from gently sloping and fairly smooth to steep and dissected. The areas are intermingled with Rough broken and stony land, from which they differ only in degree of steepness and extent of erosion. Streams traversing the type flow in deep gullies and canyons. Drainage is well established, and there are no areas of serious alkali concentration, though the underlying rocks are high in soluble salts, and a slight accumulation due to seepage sometimes occurs.

The Altamont loam is not an important agricultural soil in this survey at present, owing mainly to its inaccessibility. About 90 per cent is still in the virgin state and covered with a scant to heavy growth of brush and grasses, with a moderate growth of oak and black walnut on the northern and eastern slopes. The land is utilized principally for pasture. Most of the area cropped lies in the southeastern part of the survey. Grain and grain hay form the chief crops, with beans of secondary importance. Where the soil is deep the yields compare favorably with the returns received from the Rincon soils. There are half a dozen plantings of apricots and two small vineyards on the type. Areas of deep soil are usually chosen for fruit culture. Fertilization and irrigation are not practiced. Low prices prevail for most of the land.

One of the first steps toward the improvement of this type must be the construction of roads. Irrigation is practically impossible because of topographical features, and deep tillage and proper cultivation to conserve the limited supply of moisture are necessary measures. Contour plowing on the slopes is recommended to decrease erosion.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Altamont loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574640	Soil	1.2	2.9	1.4	8.6	19.4	48.4	17.6
574641	Subsoil	3.3	5.8	2.3	10.4	14.9	32.3	30.9

Altamont loam, light-textured phase.—The light-textured phase of the Altamont loam consists of a light grayish brown, or light-brown to brown, rather coarse sandy loam to fine sandy loam ranging from 8 to 20 inches in depth. The subsoil ranges in texture from a sandy loam or fine sandy loam to a loam, the color being

only slightly lighter than that of the surface soil. Small deposits of calcareous concentrations are sometimes present. Bedrock, consisting of soft sandstones with some shales, occurs betwen 3 and 6 feet. The surface soil is friable and in the coarser variations rather loose and porous and not so retentive of moisture as the typical Altamont loam, although it is slightly more receptive of water. The subsoil is somewhat compact and fairly retentive. The supply of organic matter is fair.

The Altamont loam, light-textured phase, is represented by small bodies in the hills about Moorpark and Somis. These occupy a rolling to hilly country. In origin, mode of formation, and general surface conditions the phase is similar to the Altamont loam. Drainage is good.

This phase of the Altamont loam is not extensive in this area. The areas of coarser sandy loam texture have an extent of less than 2 square miles and because of their location and droughty nature have a low agricultural value. One small area is cropped to beans, and the rest is used as pasture. It supports a native growth of sage brush and chaparral. There are no irrigation facilities and not much prospect of any being developed. Most of the areas of fine sandy loam texture are cropped. The few areas untilled support a growth of brush and scattered oaks. Beans, grains, and grain hay, the principal crops, give fairly good yields. Some apricots have been planted on this soil and do quite well. No fertilization or irrigation is practiced. The soil areas are more accessible than those of the typical Altamont loam, and the land commands a higher price.

Because of the somewhat open nature of the soil, cultivation to conserve moisture is important. Incorporation of organic matter and thorough tillage, aside from their value in maintaining the moisture supply, tend to increase the yields on this soil in other ways.

ALTAMONT CLAY LOAM.

The surface soil of the Altamont clay loam is a brown, or grayish-brown to dark-brown relatively friable clay loam, moderately high in silt and from 10 to 16 inches deep. The supply of organic matter is somewhat better than in the Altamont loam. The soil is usually free from gravel, but may contain shale fragments on the crests and steeper slopes of hills.

The subsoil has about the same texture as the surface soil, but ranges a shade lighter in color, being a brown or grayish brown. The structure is rather dense and compact and in exposures sometimes approaches an adobe. Water and roots penetrate less freely than in the subsoil of the loam. Small accumulations of calcareous material are sometimes present. Normally the subsoil rests on the soft decay-

ing sedimentary rocks at depths between 3 and 6 feet. In a few places on hill crests and the steeper slopes the surface soil rests directly on bedrock, and outcrops of the rock occur in places.

In certain spots, including local poorly drained areas, the soil is dark gray to black in color and resembles the Diablo clay adobe. These areas are not extensive enough to be shown on a map of the scale used in this survey.

The Altamont clay loam has a total area of 27.2 square miles. One small body lies 4½ miles north of Ventura on the west side of the Ventura River, larger areas west and east of Lacrosse, and small areas in the Santa Ana Valley. Small areas lie in the hills bordering the Ojai Valley and in the valley of Santa Paula Creek. Small to fairly extensive areas are scattered throughout the hills south of Moorpark, Simi, Santa Susana, in the Santa Monica Mountains, and elsewhere in the area.

The topography is steep to hilly and dissected by deep gullies, and the canyons are occupied by streams. Drainage is usually good, and there are no alkali areas of any size or importance. The underlying rocks contain a relatively large percentage of soluble salts, and minor accumulations of alkali occur locally. There is, however, little likelihood of a serious increase in alkali content, even in the affected areas. The type is derived from shale, sandstone, and, in places, from conglomerate.

The Altamont clay loam is not important in the agriculture of the area at present, though it is a more important soil than the Altamont loam. More than half of it is used only for pasture and supports a scanty tree growth with a light to heavy covering of brush and grasses. Grain and grain hay form the principal crops, and there is a scattered acreage of beans. There is one rather large apricot orchard on the type in the hills on the east side of Santa Paula Creek and a small olive orchard about 3½ miles northwest of Moorpark. The soils hold moisture well, and where deep the yields are fair. Fertilization and irrigation are not practiced. The lands command a low to moderate price, depending largely on their accessibility.

The construction of roads would do much to increase the use and value of this type. The soil needs to be plowed deep and given careful and frequent cultivations.

ALTAMONT CLAY ADOBE.

The Altamont clay adobe, to an average depth of 12 inches, is a brown to dark-brown clay, with a very pronounced adobe structure. It is very sticky and plastic when wet and hard and cracked when dry. When plowed under proper moisture conditions the soil breaks

down into small angular particles, but cultivation is difficult unless undertaken when moisture conditions are right. The soil is low in organic matter.

The subsoil is a light-brown or brown clay loam or clay, generally compact in structure and in places containing slight concentration of lime. It rests on bedrock consisting of shale and sandstone at varying depths, in most places at 2 to 3 feet below the surface. A zone of partly weathered rock lies between the subsoil and the unaltered rock.

Small areas lie in the southeastern part of the Santa Ana Valley, in the hills north of Simi Valley, north of Arroyo Santa Rosa, and scattered through the Santa Monica Mountains. It occupies rounded hills and valley slopes and has moderately to steeply sloping, though smooth, surfaces. Drainage is excessive, and erosion is active along water courses.

The native vegetation is largely herbaceous, but in places consists of a mixed growth of brush. A small proportion of the type is in pasture, the rest being used for the production of grain, of which the yields are fair. A small acreage is planted to beans. There are one or two orchards of prunes and apricots. The type has only a moderate to low agricultural value, owing to the difficulty of tillage, the steep topography, and uncertain yields. Some of it is reached by very poor roads.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Altamont clay adobe:

Mechanical analyses of Altamont clay adobe.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574644	Soil	0.4	1.2	1.1	5.0	7.7	33.3	51.1
574645	Subsoil	.6	1.0	1.0	5.7	8.1	37.5	46.0

DIABLO CLAY ADOBE.

The Diablo clay adobe consists of 10 to 16 inches of dark-gray to black or brownish-black clay. It is extremely sticky when wet and is difficult to plow when in this condition, and also when too dry. If tilled at the proper time, it breaks into a well-granulated crumblike mass. It is high in organic matter and lime. The texture varies somewhat locally and in places approaches a clay loam.

The subsoil is a grayish-brown or a brownish-gray clay, in most places more compact than the surface soil. It sometimes extends to 6 feet or more, but the average depth is between 3½ and 4½ feet. It is usually calcareous, but concentrations of lime are not evident in all

places. In shallow phases of the type the subsoil is sometimes absent, and the surface soil rests directly on the bedrock. In gently rolling situations where there are some colluvial accumulations, the underlying rock lies at depths somewhat greater than the average. In this survey the parent material consists largely of siliceous shales, and neither the rocks nor the resulting soil and subsoil are as uniformly calcareous as typical.

The Diablo clay abode is inextensive in this area. It occurs in a number of small areas southwest of Fillmore and in the Simi Hills and Santa Monica Mountains. The topography is rolling to fairly steep and hilly. The areas in many places lie adjacent to the Altamont soils, and like them may be surrounded in part by Rough broken and stony land. The position of the type gives it good drainage, but the run-off is not as great as the sloping surface would indicate, the structure of the soil favoring absorption.

The Diablo clay adobe is nearly all under cultivation, but because of its small extent is relatively unimportant. It is devoted mainly to the growing of beans, grain, and grain hay, usually without irrigation. With proper tillage the yields are very satisfactory for this type of land. A small area is used for miscellaneous crops.

Land of this type commands a fair price, values being determined largely by accessibility and general location.

The following table gives the result of mechanical analysis of a sample of the soil of the Diablo clay adobe:

Mechanical analysis of Diablo clay adobe.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574660.....	Soil.....	0.3	0.8	0.4	1.9	8.5	42.2	46.1

OLYMPIC LOAM.

The color of the Olympic loam is brown or grayish brown, with minor variations of dark brown. The texture is typically a loam, and large amounts of silt or of coarser textured sandy material are present in a few places. The depth varies from 12 to 20 inches. The soil is fairly friable in structure and is not difficult to till. It retains moisture only fairly well and is usually low in organic matter.

The subsoil, when present, extends to bedrock. It is of the same or slightly heavier texture than the surface soil and is light brown to brown in color, with here and there a reddish-brown tinge. It is often quite compact, and no concentrations of lime are apparent in soil or subsoil. The bedrock occurs at depths varying from 1 to 6

feet below the surface but usually lies at depths less than 4 feet. The upper part is generally weathered.

As mapped, the type includes small areas of gravelly loam. These areas lie mainly in the southern part of Conejo Valley and are shallow, droughty, and difficult to till. In other respects they resemble the loam. This variation is shown on the map by gravel symbols.

Areas of the Olympic loam occupy the slopes of Conejo Valley and the small valley lying to the south. Several small bodies are also mapped at the east end of Potrero Valley, in the eastern end of Russell Valley, and in the Santa Monica Mountains. The topography is sloping to rolling and hilly. On account of the steepness of the surface the run-off is rapid and erosion active. All the areas are well drained.

This is a residual soil derived from basic igneous rocks, and the type is confined to the small valleys of the Santa Monica Mountains where these intrusives are present. In its native state it is covered with a dense growth of brush.

About half of the type is cultivated. Grain and beans are the important crops, and yields of both are only moderate. The rest of the type is in pasture, which is poor on account of the brushy growth. The soil is of low to moderate productiveness. Owing to its situation in parts of the area remote from shipping points, it is sparsely settled. It has a low value, which varies somewhat with the accessibility, the character of surface, and the depth of soil material.

Olympic loam, stony phase.—The stony phase of the Olympic loam resembles the typical soil except in depth and its large content of stones varying in size from a few inches to a foot or more. Besides the loose stones scattered upon the surface, there are also small outcrops of the bedrock. The soil is shallower than that of the typical Olympic loam, bedrock usually lying at depths from 1 to 3 feet below the surface. A distinctive subsoil is generally absent.

The phase occurs in the same general region as the typical Olympic loam and is almost as extensive. It occupies higher and steeper mountain slopes. It is excessively drained and of very low agricultural value. Very little of it has been brought under cultivation, but small quantities of grain are grown on the better parts. The uncultivated area is used for pasture.

OLYMPIC CLAY ADOBE.

The Olympic clay adobe is a brown to dark-brown or, in places, slightly reddish-brown clay of pronounced adobe structure and from 1 to 2 feet deep. The soil may be underlain by a distinct subsoil or may rest directly upon the bedrock. It contains a moderate amount of organic matter and, in a few localities, numerous rounded basic igneous cobbles and bowlders, apparently derived from alluvial de-

posits, the finer parts of which have been removed by erosion. When this soil is wet it is almost impossible to work it, but with proper cultural methods it works into a well-granulated retentive seed-bed.

The subsoil is a light-brown or brown clay, or clay loam, the color being lighter than that of the surface soil. It is often compact, but apparent concentrations of lime are not ordinarily present. The material, however, is sometimes calcareous in places, an analysis of one sample showing 0.36 per cent of calcium carbonate. The upper part of the bedrock is usually weathered, and roots and water enter it without much difficulty.

The type occurs as small scattered bodies on the lower slopes of the mountains and in small mountain valleys. The topography is sloping to steep and hilly. Surface drainage is good to excessive, but subdrainage is only fair. Erosion is active and is doing some damage in places.

The native vegetation is largely grass, but includes scattered clumps of brush and cactus.

A very small body of the Olympic clay adobe on the first slope of the hills, about 3 miles east of Camarillo, departs from the typical in color, being dark gray to black instead of brown. It is derived from the same kind of rocks and except for the presence of larger quantities of organic matter, has the same general characteristics as the main type. If more extensively developed it would be differentiated. It is devoted to the same crops as the Olympic clay adobe.

The Olympic clay adobe is an inextensive type but is mainly under cultivation. Grain, the leading crop, gives satisfactory yields in favorable years. Some beans, apricots, and other crops are grown, but the yields are only moderate. This is a productive soil, but high yields are difficult to obtain because of the refractory nature of the materials. It is situated in the hills, for the most part away from the main lines of travel and at considerable distance from shipping points, but roads lead to all the bodies mapped. Few houses are built on the type, and it is usually held with larger areas of uncultivated land. The market value of the type is not high, the lighter textured soils similarly located being considered more desirable.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Olympic clay adobe.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574656	Soil	0.0	1.1	0.4	2.9	9.2	35.1	51.1
574657	Subsoil	.2	.6	.2	1.7	10.5	36.9	49.6

Olympic clay adobe, light-textured phase.—A light-textured phase of the Olympic clay adobe type is shown on the soil map. It is silty in places, and tends to become hard and refractory when dry, but does not have the pronounced adobe structure seen in the typical soil. The soil is also somewhat lighter in color than the typical soil; in other respects it is like the typical clay adobe. Two of the areas contain some gravel. The phase is utilized for the same purposes as the typical soil. It is a little more productive and is held at slightly higher prices.

RINCON FINE SANDY LOAM.

The upper 12 to 24 inches of the Rincon fine sandy loam consists of a light-brown to dark-brown friable fine sandy loam, rather low in organic matter.

The subsoil consists of a brown, light-brown, or reddish-brown, loam or clay loam, except where stratification occurs, and in such places it may be similar to, or lighter in texture than, the surface soil. It is usually compact and sometimes contains small seams or beds of gravel and cobblestones. When moist, the subsoil is comparatively soft and fairly permeable, but when thoroughly dry, it is hard and locally approaches a hardpan. Reddish iron stains and grayish calcareous mottling occur in places. The subsoil material below 5 feet is usually somewhat lighter in color and texture than the upper subsoil and generally consists of stratified beds of fine sand and silt with smaller deposits of clay and in places some gravel.

The type as mapped includes small bodies of loam, silt loam, and very fine sandy loam, all too small to map separately. It is thus variable in texture, being least uniform in texture over the steepest parts and where the areas are small. Some reworking and depositing of fresh material by small intermittent streams has taken place over the more gentle slopes and terraces.

The Rincon fine sandy loam is widely distributed over the area. One relatively large body occurs south of Somis, and several of smaller extent occur in this vicinity and in the vicinity of Moorpark. Other areas lie near Saticoy, Santa Paula, Ventura, Camarillo, and elsewhere. The type is confined to hilly country, the topography ranging from roughly rolling to gently sloping. It is developed on hills, eroded alluvial fans, and locally is found on terraces along some of the major streams. The surface is smooth except for the deeply cut gullies existing in many places. The type erodes easily, and in some instances entire fields have been ruined by careless farming. Drainage is good, and in some locations the type is inclined to be somewhat droughty. The material forming the type has been derived almost entirely from sedimentary rocks and was transported to its present position by streams. There is some evidence that the materials in some places have come under marine conditions.

Most of the area of this type is farmed. It is used for the production of beans, grain, grain hay, and to a small extent in growing deciduous fruits. Some of the higher and more remotely situated areas are devoted to pasture, largely because of their inaccessibility. Crops yield well where good care is given the soil, but the returns, except on the best areas, are not quite equal to those from the Rincon loam. Owing to the unfavorable surface features and difficulty in obtaining water for irrigation, the type is dry farmed.

Control of erosion, conservation of moisture, deep tillage, and maintenance of organic matter are features needing attention for the best returns from this type. The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Rincon fine sandy loam:

Mechanical analyses of Rincon fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574617	Soil	1.2	1.9	1.2	12.1	45.4	27.7	10.4
574618	Subsoil	1.0	2.3	1.1	14.8	38.9	26.9	14.6

Rincon fine sandy loam, coarse phase.—The Rincon fine sandy loam, coarse phase, is similar to the main type in color, but lighter in texture, owing to the admixture of varying quantities of coarse, gritty material. Soil of this character occurs in several areas in the hills northeast and northwest of Moorpark, in two areas south of Somis, and in one near the head of Fox Canyon. It is not quite as desirable for dry-farmed crops, being porous and having a tendency to drought. The phase is used for the same crops as the typical Rincon fine sandy loam, but the yields are usually somewhat lighter, as would be expected.

RINCON LOAM.

The surface soil of the Rincon loam consists of a brown friable loam containing a moderate quantity of organic matter and having a depth of 12 to 18 inches. Some areas have a grayish-brown, dark-brown, or reddish-brown color. The darker colored bodies usually lie on eastern and northern slopes, where moisture conditions are most favorable, and also in those parts where lime is most abundant. The reddish-brown shade occurs where oxidation has been most active. Some gravel is present in spots, especially along slight breaks in topography, but it seldom occurs in quantities sufficient to interfere with cultivation. The soil is shallowest and least typical on the steepest slopes and on narrow ridge crests where orosion is active. The texture is quite uniform, but locally becomes heavier or lighter

according to the nature of the original deposits. In places it is quite silty and tends to pack somewhat under beating rains, thereby increasing the run-off. Elsewhere moisture is absorbed quite readily. In general, the soil is not difficult to handle, except where the topography is unfavorable. The heavier textured parts require more cultivation to maintain a favorable seed bed than the lighter areas and are inclined to form a somewhat cloddy surface if irrigated by surface flooding.

The subsoil is typically lighter in color and heavier in texture than the surface soil. It ranges from a brown to reddish-brown loam or clay loam to clay, and is much more compact than the surface soil. In places where a tendency toward stratification exists, and locally elsewhere, the subsoil may have the same texture as, or be somewhat lighter than, the surface, but even here it nearly always has a much more compact structure than the soil and shows modification by weathering and percolating waters. The subsoil generally grows heavier to a depth of 4 or 5 feet, below which it gradually becomes lighter and more permeable. In places it is marked with reddish-brown or yellowish-brown iron stains or grayish mottles, and it is sometimes partly cemented, closely resembling a hardpan. Water enters it rather slowly, especially after protracted dry periods, but when once wet it softens somewhat and holds moisture well. It is much less favorable in these features, however, than are the recent alluvial soils of the Yolo series. Locally small quantities of lime appear in the subsoil.

The substratum resembles the subsoil in color, but is usually less compact and not quite so heavy in texture. It offers no obstruction to the downward movement of water and in places consists of stratified beds of fine sand, silt, and clay. Small deposits of gravel and cobbles are present in places in the subsoil and substratum as seams, irregular layers, or lenses, especially along escarpment faces and near drainageways.

Erosion has removed most of the surface soil on some of the steeper slopes and ridges, leaving the lighter colored subsoil exposed. Such spots may be distinguished easily in cultivated fields by their color, texture, and the inferior growth of crops. There are included with the type a number of small undifferentiated bodies of heavier or lighter texture. These are not separated on account of their small extent. On the lower, more gentle slopes the soil has been modified to some extent by surface deposits of alluvial material. These deposits are variable in texture and range from a thin surface covering to layers more than a foot thick.

The two small bodies of Rincon loam near the crossroads, about 4¾ miles northwest of the reservoir in Russell Valley, vary from the typical in having been deposited as a shallow covering over shales

and basic igneous rocks. These two bodies resemble the typical material in essential features, but are more gravelly. They are droughty and somewhat lower in organic matter than the typical soil and contain small quantities of material derived from basic igneous rocks.

Two gravelly areas of very small extent occur in the Conejo Valley and 1½ miles northeast of Moorpark. These are shown on the map by gravel symbols and resemble the typical soil except in gravel content, lower organic-matter content, a somewhat greater tendency to drought, and greater difficulty of tillage.

The Rincon loam is fairly extensive, occurring in numerous areas in the central part of the survey from the Ventura River to the eastern boundary. It is most extensively developed in the hills north and northeast of Ventura, north and east of Saticoy, northwest of Santa Paula, and on the southern slopes of South Mountain and Oak Ridge. Smaller areas lie in Santa Ana Valley, in the hills west of Fillmore, along the valley margin east of Piru, in the hilly areas around Simi, in the Conejo Valley, and on the higher elevations near Newbury Park.

The type is almost entirely confined to hilly or elevated terraces and foot slopes and does not occur on the valley floors. It occupies the more gentle slopes in country of roughly rolling or hilly topography. It consists in places of remnants of high dissected terraces and sometimes extends into the valleys as gentle foot slopes or as old eroded alluvial fans. The surface is in most places smooth but locally is crossed by deep narrow gullies with perpendicular banks. It is associated with rough broken and stony land, from which it often differs only in degree of steepness. Its tendency to erode and form gullies during periods of heavy rainfall is one of the important problems in farming it. The type is much older than the types of the Yolo and Dublin series and was deposited partly under marine conditions by streams issuing from the sedimentary formations to the north. Small proportions of material were contributed by the lower, feebly cemented shale and sandstone hills lying within the area. The material was elevated and upturned subsequent to its deposition and is now either undergoing destructive erosion or is gradually being covered by fresh alluvial sediments. The type is well drained, and the water table is far enough below the surface to make the accumulation of alkali unlikely.

The Rincon loam is an important soil, utilized principally for the production of beans, grain, and grain hay. Some of the steeper and more remote areas are used for pasture, and parts of the more favorably situated areas have been planted to apricots and citrus fruits. The type is quite retentive of moisture and gives good yields under dry farming, except with citrus fruits, which require irrigation. Yields of annual crops are not quite as heavy as on the more gently

sloping recent alluvial soils. In its native state the type supports a moderate growth of grass and scattering brush, with some oak on northern and eastern slopes. No fertilizer is used except for citrus fruits. Contour plowing and terracing are practiced by the more successful fruit growers. The type appears well adapted to the crops grown.

Land of this type varies in price, with difference in location, accessibility, and surface features. Few homes occur on the type, and parts of it are poorly supplied with roads, owing to the unfavorable topography.

Rincon loam, silty phase.—The Rincon loam, silty phase, consists of 12 to 22 inches of brown to dark-brown, rather friable, open-structured silty loam, relatively high in very fine sand and containing in some places, usually along breaks in topography and near adjoining gravelly soils of the Yolo series, a small proportion of gravel. The soil is comparatively uniform in color and texture, but is somewhat darker on gentle slopes and in places most protected from the sun's rays. The soil contains a moderate amount of organic matter and absorbs moisture readily. It erodes badly, however, and careful handling is necessary to prevent injury from this cause.

The subsoil is of lighter brown color than the surface soil and in many places has a distinctly reddish-brown or yellowish-brown appearance. Where typically developed, it is a heavy, compact loam or clay loam, containing in places small seams or lenslike masses of gravel. In other places it may be somewhat lighter in texture than the surface material, especially where the material is stratified. Small yellowish or reddish iron stains and spots of mottled grayish limy material are present in places. These mark the course of percolating water and are indications of age. Similar conditions do not exist in the recent alluvial types. In places the subsoil is semicemented and when dry absorbs moisture rather slowly until it becomes wet, after which it softens and becomes more permeable. The substratum consists of upturned assorted beds of silt and fine sand, with smaller amounts of clay and gravel. It resembles the subsoil closely in color, but is usually somewhat lighter in texture and more permeable to roots and water. It is many feet deep in most places, but occasionally in areas of consolidated formations it may rest upon rock at a depth of 5 feet or so.

The phase includes small patches of silty clay loam and very fine sandy loam of the Rincon series. It also in many places resembles the typical soil so closely that differentiation is difficult. The small body about 1 mile northwest of Ventura resembles the Pleasanton loam in having a gravelly substratum. It is somewhat lighter in color than typical and has been more or less reworked by small intermittent streams which have spread small quantities of fresh alluvial

material over part of the surface. Gravel in such places is more abundant than in the typical areas, but it is not present in sufficient quantities to warrant separate mapping.

The Rincon loam, silty phase, is comparatively extensive, although confined to the hilly parts of the area. The largest bodies lie on the slopes along the north side of Arroyo Las Posas. Other important areas occur in the foothills south of Simi, several about 2 miles southwest of Moorpark, and a number about 1½ miles north of Somis. Smaller bodies are found in other parts of the survey.

The Rincon loam, silty phase, has mainly a hilly or rolling topography, though a part of it consists of old alluvial fans of gentle to moderate slope, with an undulating or dissected surface due to erosion. Parts of the type along important drainageways lie on high terraces, marking different levels of the streams forming them. The more elevated areas are usually steep and are generally associated with rough broken and stony land. The surface is smooth for the most part, though in places it is dissected by narrow, deep gullies. The phase has aged considerably, as indicated by its heavy subsoil and translocation of minerals from soil to subsoil and substratum. It is derived from old alluvial deposits laid down in its present position, partly under marine conditions and in part as alluvial fans, by ancient streams flowing through regions of sedimentary rocks to the north and northeast. A small proportion of the materials has come from the soft sandstones and shales occurring in the hills within the area. The more gentle slopes and the terraces are gradually being covered by fresh alluvial deposits. Erosion is slowly reducing the extent of the phase on the steeper slopes. Drainage is well established.

The phase is mostly under cultivation and compares favorably with other old valley-filling types. The lower and more uniformly sloping portions are used for the production of beans, grain, and grain hay, and to some extent for fruits; while the less favorably situated bodies difficult of access are devoted principally to grain, grain hay, and pasture. Where the soil is well handled good yields are obtained. The steeper slopes, especially where directly exposed to the afternoon sun, give the lightest yields. Practically all the crops are produced without irrigation, with little or no fertilizer.

Much of the phase is held in large tracts and is sparsely settled. The price of the land usually ranges above $100 an acre for the most favorable portions, but is much lower for remote areas and where the topography makes cultivation difficult.

Deep tillage, conservation of moisture, control of erosion, and the maintenance of organic matter are the leading features requiring attention for the best returns from the phase.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Rincon loam, silty phase:

Mechanical analyses of Rincon loam, silty phase.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574621	Soil	0.3	0.9	0.8	6.6	32.8	45.8	12.7
574622	Subsoil	.2	.9	.6	5.1	23.6	48.9	20.6

Rincon loam, calcareous phase.—The soil of the Rincon loam, calcareous phase, ranges in color from brown to dark brown. It varies in depth from 12 to 24 inches and is friable, permeable, and easily tilled. It contains a moderate amount of organic matter, the proportion being less on the steeper slopes, where shallower soils, more active erosion, and greater loss of moisture tend to reduce plant growth. The soil becomes somewhat darker in color when wet and is subject to some variations in texture. Parts resemble a fine sandy loam, and in areas of deeper soil and gently sloping surface the texture may closely approach a clay loam.

The subsoil is brown, light brown, or slightly reddish brown and is ordinarily heavier in texture or more compact in structure. Where the subsoil is stratified the texture may be the same or slightly lighter than the surface soil. It is sometimes streaked with yellowish or reddish iron stains and characteristically mottled with grayish marly material, which in places is cemented in small seams or lenses. The lime varies considerably in quantity, and in some places apparently is lacking. Where most abundant and near the surface it appears to have had some influence on the color of the soil, as in such places the soil is darker than where the concentration is not so great or lies at greater depths. The heavy subsoil and marly material seldom extend to depths below 6 feet. Following dry periods, the subsoils absorbs water quite slowly, owing to its compact structure, but when once wet it softens and retains moisture well. The substratum below 6 feet usually consists of light-brown semistratified deposits of fine sand, silt, and clay, with occasional seams and local beds of gravel. It is lighter in texture than the subsoil and usually possesses a more open structure. These unconsolidated sediments extend to great depths.

The phase as mapped includes small bodies of clay loam and fine sandy loam of the Rincon series. It also varies in texture on the broad ridge crests and on steep slopes. The fine sandy loam which is included with the phase because of small extent, is confined to the hilltops and ridges of the uplands south of the Las Posas Valley. The soil is somewhat more friable and more easily tilled than the

typical soil, and is slightly more permeable to water, but in other respects is similar.

The Rincon loam, calcareous phase, is not extensive. Small areas occur in the hills south of the Las Posas Valley, and others in the lower hills about 3 miles northeast of Moorpark. The topography is varied, but principally sloping, rolling, or hilly and dissected. In one or two places the phase occupies terraces whose surface has been greatly modified by erosion. It lies above the valleys and erodes quite badly, small gullies forming rapidly during periods of heavy rainfall. In several places erosions 20 feet or more deep with perpendicular banks have formed on the lower slopes. The material giving rise to the phase consists of old alluvium transported from regions of sedimentary rocks to the north and northeast at a time before the present valleys were formed. Since deposition the soils have been elevated and the strata considerably tilted.

In its natural state the phase supports a moderate to good growth of grass and bur clover, with some brush in places. Most of it is now under cultivation, beans, grain, and grain hay being the principal crops. Moderate to good yields are obtained in favorable years. The crops are grown without irrigation which on account of the elevate, hilly surface of the phase, is not practicable. No fertilizer is used. There are few houses on the land, which is held in rather large tracts. It is all well situated and well supplied with roads. Land values are about the same as for other similarly situated old valley-filling soils, and are usually somewhat lower than for soils of similar texture in the recent-alluvial series lying at lower elevations.

RINCON CLAY LOAM.

The surface 12 to 22 inches of the Rincon clay loam is brown to dark brown or dark grayish brown in color. The soil is hard and compact in untilled areas when dry, and in the areas of darker color, lying near types of the Montezuma series, it tends strongly toward an adobe structure. The soil varies greatly in texture and color in different places, the lightest texture and lightest color being commonly related. Areas of heavy texture and darker color are in most places associated with more gently sloping topography. In certain localities the soil has a silt content and is somewhat less friable than is typical and is difficult to till except under favorable moisture conditions. A very small amount of rounded sandstone and quartzose gravel is present locally, but not in sufficient quantities to interfere with tillage. Gravelly areas occur only on ridge crests in localities of sudden changes in topography, and near the boundaries between this and gravelly types. The soil has a moderate to high content of organic matter, which greatly increases its power to absorb and retain moisture.

The subsoil to a depth of about 5 feet typically consists of a brown or light-brown to somewhat reddish brown clay loam or clay, in most cases somewhat more compact than the surface soil. In places its texture is somewhat lighter than the surface soil, owing to the nature of the original deposits. The subsoil below 5 feet and the substratum ordinarily resemble the upper subsoil in texture, but are frequently less compact and more permeable. They are also more or less stratified, consisting of layers of fine sand, silt, or clay, with occasional seams or lenses of gravel. In most places the strata are sharply tilted. Small reddish-brown or yellowish-brown iron stains and occasional gray mottles of marly material are sometimes visible in the subsoil. Local tendency toward hardpan exists. The subsoil absorbs water slowly after periods of dry weather, though when once moist the material softens considerably and becomes much more permeable.

The type includes small areas of dark-gray or black soils (Montezuma clay loam adobe or clay adobe), and in its terrace positions sometimes has a gravelly substratum resembling that of the Pleasanton series. The soil is deeper on the more gentle slopes. In places small intermittent streams have reworked the surface material and deposited a shallow covering of recent alluvium.

The Rincon clay loam covers 1.1 per cent of the area surveyed. It occurs principally in the foothills north of Dume Point, east of Somis, and along Adams, Wheeler, Sexton, and Aliso Canyons. Several areas of moderate size are located in Arroyo Las Posas, and several lie north and northeast of Newbury Park. Other small bodies occur in the hilly areas north, northwest, and southwest of Moorpark, northwest of Simi and east of the Ventura River, in the Santa Ana Valley, and in the foothills in the northern part of Russell Valley. Most of the areas are small and irregular in outline, and many areas are nearly surrounded by rough broken and stony land. The type is confined to the hilly parts of the area and occurs only as occasional isolated knobs in the valleys.

The type varies greatly in topographic features. For the most part it forms hilly, rolling, or moderately sloping areas, the latter representing partially eroded fans and foot slopes. Parts of the type differ from rough broken and stony land only in degree of steepness or of erosion, and small areas of rough broken and stony land, too small to map, are included when lying entirely within areas of the type. The surface is usually smooth and offers few obstructions to tillage. The material giving rise to the type has been brought by streams mainly from the mountains to the north, but there has been some admixture of materials from the softer and more recent sandstones and shales in the hills lying within the area. The material was laid down partly under marine conditions and partly as

old-alluvial deposits. Drainage is well established, but the high soluble-salt content of the rocks from which the material comes has resulted in small surface accumulations of alkali in places, such deposits existing even on ridge crests and steep slopes. The quantity of salts present, however, is not great enough to be serious, and there is little danger that the concentrations will increase, because of the sloping surface and good drainage.

This soil is utilized almost entirely for dry-farmed crops, on account of its elevated position, irregular surface, and the high cost of obtaining water for irrigation. The type is used mainly for the production of beans, grain, and grain hay, and for pasture. Deciduous fruits are grown in some places, but the soil is not so well adapted to them as is the loam. If well tilled, the type is retentive of moisture and gives moderate to good yields of the annual crops mentioned. The type erodes quite badly, but to a less extent than the Rincon loam. Deep contour plowing is generally practiced to prevent injury from this cause. The areas of this type used for pasture either are held in large tracts or are remote from towns and poorly supplied with roads. Land values vary, depending upon location, surface features, and roads, and are about the same or slightly lower than for the Rincon loam. The type is usually held with other more desirable land and is rarely used for home sites.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Rincon clay loam:

Mechanical analyses of Rincon clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574623	Soil	0.3	1.8	1.6	11.8	28.1	30.4	25.6
574624	Subsoil	.3	1.4	1.1	9.8	28.2	32.8	26.1

PLEASANTON GRAVELLY SANDY LOAM.

The surface 12 to 18 inches of the Pleasanton gravelly sandy loam consists of a loose, friable, gravelly, sandy loam relatively high in fine sand. The color is prevailingly brown, but ranges to dark brown. It contains a fair amount of organic matter, but the structure is so open and porous that the power of the soil to hold moisture is low. In spots the texture grades toward a gravelly fine sandy loam, but the difference is of no agricultural importance. Large rounded waterworn cobbles and bowlders are scattered over most of the type. Areas of excessive stone content are indicated on the soil map by symbols.

The surface soil grades imperceptibly into the subsoil. The color of the latter ranges from brown to reddish brown, and the texture is slightly heavier, closely approximating a loam. The structure is much more compact than in the soil, and the power to hold moisture is greater, but water and roots penetrate it without much difficulty. The subsoil contains rounded bowlders derived from sedimentary rocks. The change from subsoil to substratum is not sharp. Ordinarily it takes place between the depths of 4 and 6 feet. The substratum resembles the subsoil in color, but normally contains more sandy material and bowlders, is less compact, and has a low moisture-retaining power. It is usually many feet in depth, but in places it forms a veneer over shales of the sedimentary hills.

The Pleasanton gravelly sandy loam is confined to a few areas in the northwestern part of the survey. Most of these lie in the Ojai Valley, but there is one in the western end of the Santa Ana Valley.

The soil is formed from old-alluvial deposits and lies at considerable elevations above the stream bottoms, from which it is separated by steep bluffs. The topography is gently rolling or sloping to steep, hilly, and dissected. The largest area, which lies in the eastern part of the Upper Ojai Valley, is so dissected over much of its extent as to be almost unfit for agriculture. Drainage of this type is excessive.

The type is droughty and of very low agricultural value, and little of it is used except for pasture. It supports a scattered to dense growth of brush, with a few oaks on the smoother areas. It must be cleared of the larger stones and brush and irrigation supplied before most crops can be grown successfully.

The following table gives the results of a mechanical analysis of a sample of the soil of the Pleasanton gravelly sandy loam:

Mechanical analysis of Pleasanton gravelly sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574646.....	Soil.....	5.0	17.8	9.8	24.6	14.8	16.9	11.1

PLEASANTON GRAVELLY LOAM.

The Pleasanton gravelly loam consists of 12 to 20 inches of loose, friable, brown gravelly loam, in places closely approximating fine sandy loam. It contains only a moderate supply of organic matter, and as the soil is loose and open in structure its water-retaining capacity is relatively low. Moisture is absorbed readily, and there is practically no loss from run-off.

As is the case with the gravelly sandy loam of this series, lines between the soil and subsoil or between the subsoil and substratum are not sharp. The subsoil ranges in color from a light brown or light reddish or yellowish brown to medium brown. In places it approximates a gravelly clay loam in texture. It is more compact and holds water better than the surface soil, but roots penetrate it with little difficulty.

The substratum, which in most areas lies at depths between 4 and 6 feet, is similar to that of the other types of the Pleasanton series. It carries a relatively large proportion of cobblestones and some large bowlders in a matrix of sandy loam or loam and is so porous as to increase the droughty nature of the type. The substratum is usually many feet thick.

The Pleasanton gravelly loam is of small extent. Its most extensive development is in the region from Santa Paula Creek eastward to the Sespe Creek Valley. One small area occurs on the west side of the Ventura River near Lacrosse. Others are mapped along Matilija Creek, 4 miles southwest of the town of Ojai, in the northern and eastern parts of the Ojai Valley, and northeast of Piru.

The soil represents remnants of old-alluvial deposits formerly very much more extensive. The topography is gently sloping to moderately sloping or hilly, with generally smooth contours, except near deeply-eroded stream channels. Drainage is good to excessive.

More than 50 per cent of this type is still in a virgin state and is used as pasture. It supports some grass and a moderate to heavy growth of brush. A number of crops are grown, but the acreage of none is large. Grain and grain hay occupy the largest area, and beans are among the field crops grown to some extent. There are orange groves of importance in the Ojai Valley and northwest of Fillmore. Among the fruits, apricots and lemons rank next in acreage. A few small plantings of olives, pears, grapefruit, avocados, and grapes have been made. The citrus fruits are irrigated and fertilized and do very well. The other fruits and field crops are dry farmed without the use of fertilizers. The results are fairly satisfactory when proper methods to conserve moisture are followed. The land is held at low to fairly high prices, depending mainly on accessibility. High prices are often justified, especially northwest of Fillmore, where the surface and slopes are ideal for irrigation. This also applies to the bodies in the Ojai Valley, where parts of the type are irrigated.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Pleasanton gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574650	Soil	1.8	3.2	2.0	8.3	33.8	33.5	17.6
574651	Subsoil	5.3	14.8	7.4	13.5	11.5	17.5	29.8

PLEASANTON LOAM.

The Pleasanton loam is a brown loam with light-brown, reddish-brown, yellowish-brown, and dark-brown color variations. Normally the surface soil ranges from 10 to 16 inches in depth, but along breaks and escarpment faces the gravelly substratum may approach within less than 10 inches of the surface. Small quantities of gravel and cobblestones are present in places but do not seriously affect tillage. The texture is somewhat variable, tending to become heavier and quite silty in the more level areas, and in spots on hillsides and where erosion has been active approaching a fine sandy loam or gravelly loam. The organic matter content is moderate to low, and the soil inclines to be slightly droughty. Tillage is usually not difficult, and water penetrates the soil readily.

The subsoil varies rather widely in color, ranging from brown, light brown, or yellowish brown to reddish brown. It is usually more compact than the surface soil and is generally heavier in texture. When it is dry, roots and water enter slowly, but when once moist it becomes more permeable. It is retentive of moisture. The substratum contains rounded cobblestones and occasional bowlders of sedimentary rocks. The interstitial material ranges in texture from a sandy loam to loam. This stratum lies in most places at depths between 4 to 6 feet, but may be deeper in flat or undulating areas. It is easily penetrated by roots and water, and where the subsoil proper is only a few inches thick or entirely lacking the type is somewhat more droughty. Locally the substratum is wanting and is ordinarily most important as a soil factor near breaks in topography and along escarpment faces. In places the type occurs as a veneer of old-alluvial material 4 to 8 feet deep, resting on shale rock, but ordinarily the material is much deeper.

Two small bodies of Pleasanton loam, 4½ miles west of Fillmore, represent a departure from the typical soil, being characterized by a distinct reddish-brown color and resembling material of the Corning series. The soil of these areas contains less organic matter and is less retentive of moisture, making dry farming more hazardous.

With the exception of two areas situated at the eastern end of the Conejo Valley, the Pleasanton loam is confined to the northern and western parts of the survey. Several small areas lie west of the Ventura River on the hills adjacent to the ocean. There are areas along San Antonio Creek and in the Santa Ana Valley as well as along the west bank of the Ventura River to the north and along the east bank south of this valley. Others occur in the northern part of the Ojai Valley, in the Upper Ojai Valley, and 2 miles northeast of Santa Paula.

The type has a gently to moderately sloping or rolling topography and lies at a higher elevation than the associated recent-alluvial types of the Yolo Series. In places it is deeply dissected by drainageways, but where erosion has not been so active the surface is fairly smooth. The type is derived from old-alluvial deposits. Drainage is good, and where the substratum lies near the surface it may be excessive.

While not an extensive type, approximately 75 per cent of it is under cultivation. Grain, grain hay, and beans, which occupy the largest acreages, give fair yields under favorable conditions. The apricot is the most important fruit; there are about half a dozen orchards on the type. A few olives, prunes, walnuts, oranges, and peaches are grown. Oranges are the only crop irrigated and fertilized. Yields are only fair as compared with those obtained on the recent-alluvial soils, and in dry years, or where a poor system of tillage is practiced, the trees usually show a need of water. The land is held at a moderate price, and all of it is accessible.

OJAI VERY FINE SANDY LOAM.

The surface soil of the Ojai very fine sandy loam consists of a pale-yellow, yellow, or reddish-yellow friable, very fine sandy loam of uniform texture, 10 to 18 inches deep. The reddish-yellow color is most pronounced in the area situated in the eastern part of the Ojai Valley, evidently where oxidation has been greatest. Along bluffs and on abrupt slopes the gravelly substratum characteristic of this series may lie within 2 or 3 inches of the surface, while in swales and level spots where there has been some reworking and deposition of recent material the surface soil may extend to a depth of 24 to 36 inches. A few cobblestones are scattered over the surface in local spots, especially near escarpment faces. The soil is deficient in organic matter and is inclined to be droughty. Rainwater enters it readily, but its power to hold moisture is low.

Typically, the subsoil is lighter in color and heavier in texture or more compact in structure than the surface soil. It is usually a heavy, fine, sandy loam to clay loam and varies in color, being light

yellow to brownish or reddish yellow. The structure is compact and nearly always shows the characteristics found in soils subjected to long periods of leaching. Roots do not find such a favorable medium for development in it as in the subsoils of recent-alluvial types. In places the subsoil is absent, and the surface soil rests directly upon the gravelly substratum, which contains large waterworn cobblestones and bowlders composed of sedimentary rocks. The interstitial material consists of sand, silt, and clay, in varying proportions, but for the most part it is a sandy loam to loam in texture. The substratum is easily penetrated by roots and water and tends to make the type droughty and otherwise impair its crop value, especially in the areas of shallow soil without subsoil. Where typically developed, the substratum lies from 5 to 6 feet below the surface, and it is in general many feet thick. In places the gravelly substratum is lacking, but only in irregular areas of little importance and too small to map.

Included within the type are several small undifferentiated bodies of similar soil of fine sandy loam texture. The color, structure, subsoil, and substratum characteristics of these areas closely resemble those of the typical soil with the exception that the reddish cast is not so pronounced. There are two areas of this description in the Santa Anna Valley, a medium one 1½ miles south of Ojai, and another at the extreme eastern end of the Ojai Valley. Four miles southwest of Ojai the characteristic substratum of the type rests upon tilted shales at depths varying from 6 to 15 feet.

The Ojai very fine sandy loam is confined to the northwestern part of the survey. The largest body covers several square miles and extends southwest and west from the town of Ojai to the Ventura River, and thence along the eastern bluff for more than 6 miles. There are two areas close together on the opposite side of the Ventura River at the eastern end of the Santa Ana Valley, and a large area covering much of the eastern half of the Upper Ojai Valley.

Most of this type has an undulating topography, but some of it is hilly. Along streams it may occupy bluffs varying in height from a few feet to 40 or 50 feet. In general, the surface is fairly smooth except along the streams, where it is more or less dissected. The drainage ranges from good to excessive, the latter condition existing in areas with the porous gravel substratum lying close to the surface. The type has the same origin as the Pleasanton soils. No alkali is present, and there is no liklihood of future accumulations.

The Ojai very fine sandy loam is of only moderate agricultural importance. The virgin soil supports a scattered to fairly dense growth of brush, oaks, and grasses. The uncultivated area, about 20 per cent of the total, is used for pasture. The rest is used mainly for the production of grain and grain hay. There are small scat-

tered fields of beans. Among the fruits, the apricot leads, the orchards covering 600 or 700 acres. Citrus fruits, almonds, olives, and prunes are grown to a small extent. The type is not only deficient in organic matter and lime, but also apparently low in productive power in general. Citrus fruits do fairly well and are the only crops fertilized and irrigated. Deciduous trees show the need of water, especially in dry years, and they do not possess the vigor nor attain the size of those planted on the recent-alluvial soils. Annuals give only fair returns. Farming land of this type brings only a moderate price.

In many cases the introduction of some system of irrigation if trees are grown, the plowing under of manure or cover crops to increase the organic-matter supply, together with deep tillage and careful cultivation, are measures necessary for the improvement of this type.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Ojai very fine sandy loam:

Mechanical analyses of Ojai very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574648	Soil	1.4	4.5	3.3	15.3	36.5	31.6	13.6
574649	Subsoil	2.3	6.6	4.0	17.5	19.8	28.3	21.2

MADERA SANDY LOAM.

The color of the Madera sandy loam is brown, grayish-brown, or, rarely, dark brown. The texture is typically a rather coarse sandy loam or sandy loam, but over parts of the type the soil is relatively high in fine sand, and the texture approaches a fine sandy loam. The depth averages about 12 inches, and the soil passes into the subsoil gradually. The structure is friable, and cultivation is easy. The material absorbs moisture readily, but does not retain it well because of its open structure and low organic-matter content.

The subsoil in most areas is a little lighter colored than the soil, being a light brown or light reddish brown. It is a sandy loam or loam in texture and in most places compact. It extends to a depth of 2 to 4 feet, at which depths it is underlain by a brown, firmly cemented hardpan from 2 to 6 feet or more in thickness. This hardpan has apparently formed as the result of the infiltration of iron salts. The substratum consists of beds of stratified material of varying texture.

Over much of the type there is considerable fine gravel present, but the proportion of such material is not great enough to warrant

mapping these areas as a gravelly soil. About 1 mile southeast of Epworth an area mapped with this soil less than 100 acres in extent, is of lighter texture, closely approaching a sand. The soil here has shown the effect of wind action. This area is much less productive than the rest of the type. In the eastern part of the Conejo Valley there is a small body of included material of loam texture. The subsoil resembles the surface soil, and the hardpan is characteristic of the type. In many places a small deposit of recent alluvial soil occurs as an overwash. This overwash increases the productiveness of the type.

The Madera sandy loam occurs mainly north, northeast, and northwest of Moorpark and extends from the town northward to the nonagricultural land of Oak Ridge. It occupies flat-topped ridges or mesas, which usually have steep or precipitous sides. Small bodies or narrow strips of the soil may lie on low rounded hills. The hardpan is often exposed on the steep hillsides. The valley in which Fairview and Epworth are located is a slight depression in the large mesa in which there is an overwash of recent alluvial types. Erosion is active and has formed many deep arroyos in the mesa which are gradually encroaching upon the cultivated land. Surface drainage is good, but subdrainage, on account of the hardpan, is very deficient.

This soil has been derived from old valley-filling deposits which have become weathered and modified and have developed a hardpan. Sedimentary rocks have given rise to the material forming the type in this survey.

The native vegetation is brush and grass. Most of the land has been cleared and farmed, but it is only moderately productive. Grain and beans are the leading crops. Apricots and olives have also been planted to some extent.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Madera sandy loam.

Mechanical analyses of Madera sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574658	Soil	13.4	19.0	7.0	16.7	18.2	17.7	7.7
574659	Subsoil	9.3	18.3	7.2	19.1	17.4	20.2	8.2

MONTEZUMA CLAY ADOBE.

The soil of the Montezuma clay adobe is a dark-gray to brownish-black clay. The material is plastic and sticky when wet, but forms a hard, compact mass when dry which cracks and disintegrates in

the way characteristic of true adobes. Thorough cultivation reduces checking to a minimum, but in untilled areas cracks several inches wide and 3 or 4 feet deep are common. The soil is high in organic matter and is capable of holding a large store of moisture. It varies in depth from 12 to 22 inches, being deepest and most uniform on gentle slopes. Heavy beating rains tend to pack the surface, especially in the more silty portions.

The subsoil to a depth of 6 feet or more consists of a brown, light-brown, or slightly reddish-brown compact clay loam or clay. If dry it is hard and flinty, but when moist it softens materially and absorbs water readily.

The subsoil differs from the soil and plainly indicates that the materials have lain in their present position a long time. Grayish-brown mottlings or streaks of marly material are present in most places. The substratum to a depth of many feet consists of silty, sandy, or clayey layers, with local seams or beds of gravel. It is for the most part somewhat lighter in color than the subsoil, being light brown or light yellowish brown. It is generally more permeable and better drained than the subsoil. In places the type carries varying quantities of shells, indicating that some of the deposits may be of marine origin.

The Montezuma clay adobe lacks uniformity, owing largely to its occurrence in small bodies associated with other soils. Among its most noticeable variations are four small areas, one located southeast and one north of Somis, one northeast of Piru, and the other about 2 miles northeast of Tico. These are dark brown, or dark grayish brown in color and in reality belong to another series, being included with the Montezuma on account of their small extent.

Several small dark-brown or dark grayish-brown bodies of less pronounced adobe structure occur in the hills along the south side of the Arroyo Las Posas. Two small bodies, one located on an elevated terrace of the Santa Paula Creek about one-half mile southeast of Sulphur Mountain Springs, and the other in the east end of Santa Ana Valley, are also dark brown in color and have a gravelly substratum over much of their extent. They closely resemble the soils of the Pleasanton series, though rather dark in color. The two areas last named have some gravel in the soil and subsoil in places and have received small quantities of wash from minor intermittent streams.

As a whole, the Montezuma clay adobe is difficult to till, owing to its heavy texture and hilly surface. If handled when too wet it forms a puddled mass, and if plowed when dry it forms a very cloddy surface. It requires more power in plowing and more frequent cultivation to form a good seed bed than in the soils of lighter

texture, but when handled at the proper time it works into a mealy or granular tilth.

The type is inextensive in this survey. Several relatively small areas occur on the lower slopes of the Santa Monica Mountains north of Dume Point. Several areas are mapped in the vicinity of Newbury Park, others in the Santa Ana Valley, south of Fremontville and Somis, and in the Ojai and Upper Ojai Valleys.

The type is mainly confined to hilly or rolling areas, with some of moderate to gently sloping surface. It is smooth in contour, except for a few deeply cut channels and gullies. (Plate II, fig. 1.) Drainage is good, and on some of the steeper slopes somewhat excessive. Its more gently sloping portions have been modified somewhat by small intermittent streams, which have added varying quantities of fresh material in places. The soil is derived from old alluvial deposits which have been elevated and upturned since their deposition.

Beans, grain, and grain hay are the principal crops. A small but thriving orchard of apricots and some prune orchards occupy some of the type lying in the Santa Ana Valley. A small planting of apricots also occurs on it in the Upper Ojai Valley. The steepest and least favorably located parts are still used for pasture. The yields of field and orchard crops are moderately good, but the type is not as well adapted to fruit and bean culture as are soils of lighter texture, it being usually more difficult to obtain good stands of beans. As is the case with other similar types, the yields are lightest on the steeper areas and areas of shallower soil. The type varies greatly in land values, due to location and roads. It is usually held in large tracts, and dry farming is the rule.

Thorough tillage, cultivation, and careful conservation of moisture are the leading requirements for the best yields upon this type.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Montezuma clay adobe:

Mechanical analyses of Montezuma clay adobe.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574662, 574664....	Soil.....	0.3	1.0	1.1	7.5	21.4	30.6	38.5
574663, 574665....	Subsoil.....	.5	1.9	1.3	7.5	18.5	34.6	35.9

YOLO GRAVELLY FINE SANDY LOAM.

The surface 12 to 30 inches of Yolo gravelly fine sandy loam is brown, grayish-brown, or dark-brown in color, with the lighter shades prevailing. The soil is friable and possesses an open structure, except

where very gravelly, in which case it packs and loses much of the rainfall as run-off. The soil is relatively high in fine sand and very fine sand and in places is quite silty. The content of gravel varies considerably and is greatest where streams have been most active. In such places the soil may approach a gravelly fine sand in texture. The soil is rather low in organic matter. Large quantities of bowlders in addition to the smaller gravel are present in the soil mass in the areas of the type occurring in Timber Canyon, near the mouth of Santa Paula Creek, northwest and west of Fillmore, over parts of the large area east of Ojai, and in a few other places in the area. These areas are indicated on the map by stone symbols. These stony areas must be cleared of the larger stones before they can be used for crops, but such clearing is expensive.

The subsoil resembles the soil in places, but ordinarily is somewhat stratified, the material of the different layers varying greatly. The color is lighter than that of the surface material. The gravel in the subsoil is similar to that in the surface soil and consists mainly of fine-grained sandstone and quartzose rock, though northeast of Santa Paula it is composed of subangular fragments of shale. The subsoil in general is lighter in texture than the surface soil and is less compact, being permeable to water and roots. The substratum closely resembles the subsoil. Both subsoil and substratum are unretentive of moisture.

The type includes small areas of the fine sandy loam, sandy loam, and gravelly loam types of the Yolo series. It includes also a number of narrow, bare, rocky channels which carry water during part of the rainy months. Immediately along the larger streams the type is underlain by beds of loose gravel, which tend to make the soil droughty in such places. The small area lying in Arroyo Las Posas is of light grayish-brown color and is too light to be typical. If more extensive, it would be separated as a distinct soil type. It resembles the typical soil in all respects except in its lighter color and lower organic-matter content.

The Yolo gravelly fine sandy loam is extensive and widely distributed over the area. The largest area lies 1 mile east of Ojai, and important areas occur along Piru, Sespe, and Santa Paula Creeks, along Coyote and Timber Canyons, and in the upper Ojai Valley.

The topography varies, the type occupying gently to steeply sloping alluvial fans, footslopes and river bottoms. The surface is fairly uniform, except where stream erosion and deposition have been unusually active. Drainage is good to excessive. Sedimentary rocks and old valley-filling deposits have contributed practically all of the material forming the type, and much of it has been moved

only a very short distance. Varying quantities of material are being added to the surface annually by intermittent streams.

Much of the type is untilled and supports a rather heavy growth of brush. Some willow and vines are present along the streams, the areas being used for pasture. About half the area of the type is under cultivation. Lemons, oranges, walnuts, apricots, grain, and grain hay are the principal crops. Some beans are grown also. The citrus fruits and walnuts require irrigation, and apricots and beans are sometimes given one or two applications of water during the season. Yields and quality of fruit and nuts are good; the other crops do moderately well. The type does not appear to be well adapted to root crops. It responds well to applications of organic matter. Commercial fertilizers are used for citrus fruits.

Maintenance of organic matter, deep tillage, conservation of moisture, flood control, and the removal of stones are important factors in handling this soil.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Yolo gravelly fine sandy loam:

Mechanical analyses of Yolo gravelly fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574605	Soil	3.6	8.8	6.2	24.0	27.1	23.3	7.4
574606	Subsoil	3.4	8.6	7.1	29.5	27.7	18.1	5.3

YOLO SAND.

The Yolo sand to a depth of 12 to 24 inches consists of a light-brown or light-grayish-brown, light-textured sand of loamy character and containing large proportions of fine and very fine sand with little silt and clay. The soil is subject to considerable variation in texture, due to modifying agencies of wind and water. The more elevated areas and those lying near the streams often contain more coarse sand or fine gravel, while other areas are usually higher in fine sand and include small narrow strips or spots of fine sandy loam, gravel, or sandy loam. The lighter colors prevail in those parts of the type lying along streamways and on slight ridges and where the surface is undulating. Some of these small areas are of a pronounced light grayish color and represent soils of the Laguna series. The soil contains more organic matter where it occurs on the plains somewhat removed from streamways and is not subject to overflow. It is open and porous, and its power to hold water is low.

In places the subsoil resembles the surface soil to the depth of 6 feet, but generally it consists of brown or light grayish-brown strata

of materials ranging from coarse sand or gravel to loam or gravelly loam. The subsoil on the whole has a rather open structure, permitting the free movement of water. The areas along stream courses vary greatly, and in many places the soil is underlain at depths less than 3 feet by coarse sand or fine gravel. These areas may resemble Riverwash, from which they were separated, in many places, on the basis of slightly greater elevation and their growth of willow and vines. Much of the type is subject to overflow during the winter months and changes from year to year with the varying action of the floods. The parts of the type lying farther from the streams are in many places protected by windbreaks of eucalyptus, along which the sand may be piled into drifts rising several feet above the surrounding country. In places a shallow phase of the type occurs as a superimposed alluvial wash only a few feet deep over heavier types of the same series. In such places, and in minor depressions and level areas, dark-colored, heavier textured material is sometimes encountered at 4 to 6 feet below the surface. Here, as well as along stream channels, the water table is usually encountered at depths less than 6 feet. The substratum in this area usually consists of stratified sands, silt, clay, and gravel. The substratum is nearly always saturated.

The Yolo sand, which is not an extensive type, occurs in small bodies at different places along the Santa Clara River throughout its course in the area. Several areas occur along the drainageway from Somis to Simi, and one lies in the extreme eastern end of Simi Valley. Another small area is located on Piru Creek, one-fourth mile northeast of Piru.

The type is confined to the valley floors, where it occupies gently sloping alluvial fans or forms narrow strips along the stream courses. Practically all the rainfall is absorbed, but it passes quite rapidly into the subdrainage. No alkali is present. The material forming the type consists of recent alluvial sediments derived from erosions of areas of sedimentary rocks and old valley-filling soils lying principally within the survey. The type is still in process of formation, much of it being modified annually by fresh alluvial deposits.

The Yolo sand is of minor importance agriculturally, and being subject to overflow, not more than 50 per cent of it is under cultivation. Much of the untilled area lying along streamways supports a moderate to heavy growth of willow and vines and is used principally for grazing. The area under cultivation is used mainly for the production of beans, sugar beets, alfalfa, and potatoes. Some small plantings of lemons and walnuts have been made in the most favorable positions. The yields are moderate, usually less than on the sandy loam and loam types of the series. Young crops are injured to some extent by drifting sand. Applications of organic matter

materially increase the yields, in part through improvement of the conditions of moisture supply. The type is usually farmed with other more desirable lands composed of soils of heavier texture.

Additions of organic matter, flood control, and the conservation of moisture are important factors in cropping this soil.

The following table gives the results of a mechanical analysis of a sample of the soil of the Yolo sand:

Mechanical analysis of Yolo sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574601.....	Soil.....	3.6	11.0	11.5	47.1	21.7	3.0	2.5

YOLO FINE SAND.

The surface 12 to 30 inches of Yolo fine sand consists of a light-brown or light grayish brown smooth-textured loamy fine sand, in many places closely approaching a fine sandy loam texture. As mapped, it is, however, variable and includes many small patches of sand, coarse sand, gravel, or fine sandy loam. Areas occurring along stream courses are lighter in color and are subject to the greater variation owing to reworking by floods and to modification by fresh alluvial deposits. The soil is rather low in organic matter, the proportion being greater in the darker colored areas occurring in the plains and somewhat removed from the streams. The soil absorbs water readily and retains it better than does the sand of the series. In many places on the plains it has a billowy, wind-blown surface, the crests of the undulations being nearly always lighter in texture and more porous than other parts of the type. Along Ventura River and Sespe and Piru Creeks varying quantities of gravel and cobble are present in the soil, such deposits marking abandoned watercourses partly filled by finer sediments.

The subsoil to the depth of 6 feet may be similar to the surface soil in color and texture, but where streams have been more active it is usually composed of stratified beds of gravel, sand, sandy loam, or loam. The type has the most irregular subsoil along the streamways, where the materials are ordinarily coarser and more likely to carry gravel. The subsoil is usually somewhat lighter in color than the surface soil. It has an open structure and is readily permeable. Where heavier strata occur, the moisture conditions are better than where the materials are coarse and gravelly. The water table lies at depths less than 6 feet over many of the areas in the region around Oxnard and along streamways. The substratum consists of stratified beds of sand, silt, gravel, or clay, like the subsoil, being coarsest in the vicinity of streams. The substratum is saturated in most places.

The Yolo fine sand, in positions along streams, is subject to reworking and, like the sand, in many places much resembles Riverwash, except in its slightly higher position and its covering of brush and willow.

These areas are continually changing in texture as the result of floods and drifting. Wind action also influences the bodies removed from streams and gives them a slightly uneven surface, drifts several feet high lying along fences and windbreaks.

A shallow variation of the Yolo fine sand is developed where floods have spread the typical materials over other heavier soils. In such places the heavier, darker colored soils are encountered at depths ranging from 3 to 5 feet below the surface. In the flatter and lower lying plains positions several such layers may occur in a 10-foot section. They appear to mark poorly drained areas which have been occasionally covered by the material forming this type.

The Yolo fine sand, which is moderately extensive, forms many areas along the Santa Clara and Ventura Rivers, along Arroyo Las Posas, and along Sespe and Piru Creeks. Other areas lie east and south of Camarillo and in the region around Oxnard. It is one of the most recently formed soils in the area.

The type occupies gently sloping alluvial fans and valley bottoms. It has a smooth, billowy surface, except for a few drainage channels. It absorbs practically all of the rainfall, but much water is lost by percolation. In the plains around Oxnard the relatively high water table has caused the accumulation of varying amounts of alkali. Where suitable drainage outlets can be provided, the lowering of the water table and removal of the alkali are not difficult, because of the light texture and open structure of the soil. The materials forming the type represent wash from areas of sedimentary rocks and old valley-filling deposits.

Along the larger streams the Yolo fine sand supports a moderate growth of willow and brush, and such land is used principally for grazing. More than half of the type is tilled, however, beans, walnuts, apricots, and sugar beets being the main crops. Some grain and alfalfa also are grown, but the former does not yield well, and the latter is short lived. Fruits and walnuts are confined to the better drained areas and usually give good returns. The type is more desirable than the sand, but not so desirable, at least for the crops grown, as are the heavier textured types of the Yolo series. Drifting sand does some damage to young crops in spring and early summer, but windbreaks have greatly reduced trouble from this source. Applications of organic matter increase its moisture-holding properties and result in increased yields. Land values depend mainly upon location, exposure to overflow, and drainage.

Addition of organic matter, flood control, conservation of moisture, and drainage are important factors in farming on this type of soil.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Yolo fine sand:

Mechanical analyses of Yolo fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574603	Soil	2.6	6.7	5.7	40.3	30.8	10.1	3.5
574604	Subsoil	2.9	6.8	3.9	31.3	33.9	15.2	5.8

The following sample contained more than one-half of 1 per cent calcium carbonate ($CaCO_3$): No. 574603, 0.75 per cent; and No. 574604, 1.04 per cent.

YOLO SANDY LOAM.

The Yolo sandy loam to a depth of 12 to 30 inches consists of a light-brown or light grayish-brown to rather dark-brown friable, open-structured, sandy loam, the depth of color varying with the content of organic matter. While the texture is for the most part a fine sandy loam, it is generally light, in many places closely approaching a sand or fine sand. Part of the type in the region about Moorpark and west of Epworth is gritty and in places almost a coarse sandy loam or coarse sand in texture. This is the case in some of the small stream valleys and along the Ventura River, where stream action is greatest, the type in places resembling Riverwash. Bowlders and cobblestones are common in such places. The soil is generally low in organic matter, and the lighter textured areas have a tendency to drift.

In parts of the type the soil carries varying quantities of gravel. The more gravelly areas are indicated on the map by gravel symbols.

The subsoil in the typical areas consists of interstratified beds of sand, silt, or gravel, the last being most common along the streams. In places on gently sloping fans the subsoil resembles the soil in color and texture. The color of the subsoil is like that of the soil, but of lighter shades than the surface color, except where the type is formed by deposits washed over heavier and darker colored soils. It is rather porous in the higher lying positions and loses much of its moisture by percolation, but is ordinarily saturated at depths less than 6 feet. The substratum resembles the subsoil in color and texture.

In the gravelly areas the surface soil may be very gravelly and stony, with a gravel free subsoil below 18 inches, or gravel may be distributed equally through soil and subsoil. The gravel consists mainly of fine-grained sandstone and other quartzose rocks. The substratum resembles the subsoil, and both are porous and lose their moisture

quite readily. Near large streams the subsoil and substratum may consist of beds of loose gravel and sand, but the gravel content always decrease with the distance from these streams.

The type is usually variable and is subject to reworking by small intermittent streams which deposit fresh material annually. In places the deposits overlie soils of the old valley-filling group and others of recent formation. The gravelly area northwest of Ventura consists of alluvial wash from the higher lying old valley-filling deposits superimposed on heavier silts and clays, which lie 4 feet or more below the surface. Here it forms an old elevated terrrace.

Several square miles of the Yolo sandy loam are mapped. The type occurs in many small areas widely scattered over the survey.

The principal gravelly areas occupy the bottoms of Holser Canyon in the northeastern part of the survey and Happy Camp Canyon in the vicinity of Moorpark.

The type occupies gently sloping alluvial fans, valley plains, and stream bottoms and has a smooth surface easily prepared for irrigation except where stream action has been unusually active. Some alkali is present in areas on the plains around Oxnard and Leesdale. This has resulted from a high water table and stagnated underdrainage. For the most part, however, the drainage is good and the soil free from injurious accumulations of soluble salts. Reclamation of the affected areas is not difficult where outlets for drainage water can be obtained.

A large proportion of the Yolo sandy loam is under cultivation. It is devoted to a wide range of crops, chief among which are beans, sugar beets, walnuts, lemons, apricots, grain, alfalfa, and potatoes. These crops yield moderately well, but those which root deeply do best. Fruits and nuts are grown on areas with good drainage and a deep water table. The texture is rather light for the best returns, and irrigation is ordinarily necessary for the perennials. The gravelly areas along the larger streams support a growth of brush and willow and are mainly used for pasture. Drifting sand injures young plants to a slight extent, but trouble from this source is not great. Applications of organic matter give increased yields, aiding materially in maintaining the supply of moisture. Land values vary widely, but $200 or more per acre is asked for the better areas.

YOLO FINE SANDY LOAM.

The soil of the Yolo fine sandy loam consists of a brown, grayish-brown, or dark-brown, friable, open-structured fine sandy loam from 12 to 30 inches deep. The soil is somewhat variable in texture and in many places contains a relatively large proportion of very fine sand. Some gravel and cobblestones are present locally, especially along the streams and where minor drainageways cross the small

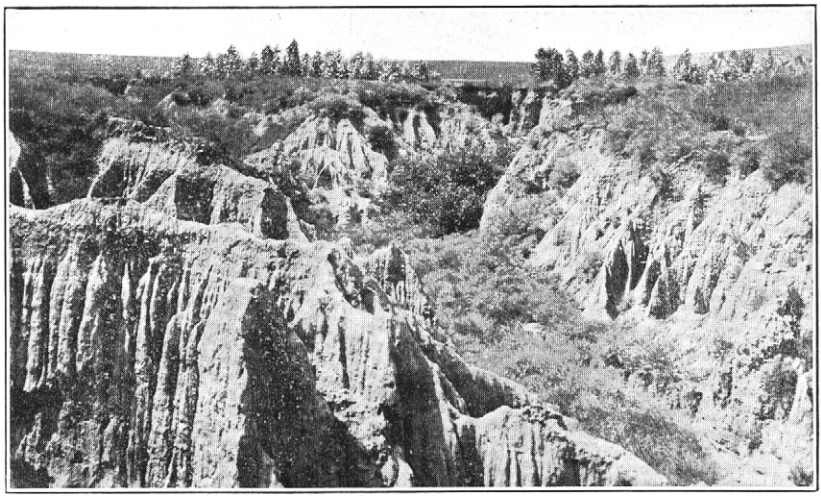

PHOTO FROM UNIV. CALIF.

FIG. 1.—EROSION IN THE MONTEZUMA CLAY ADOBE ON HILLSIDES NORTH OF SPRINGVILLE.

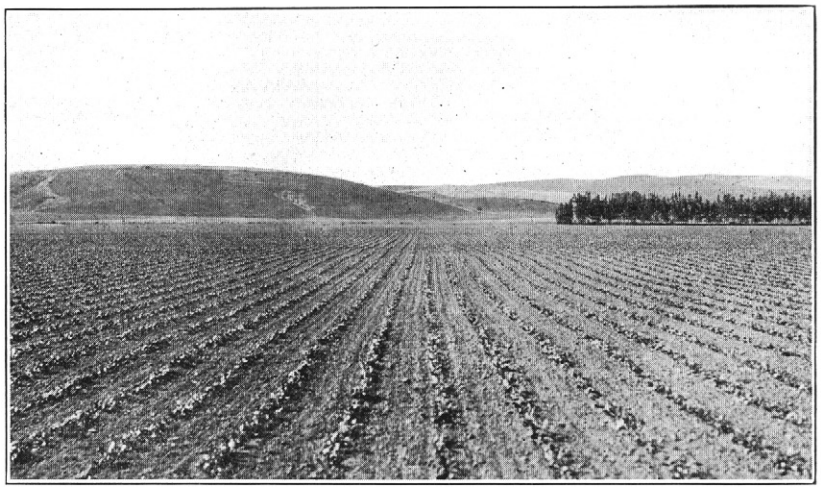

FIG. 2.—LIMA BEANS ON YOLO FINE SANDY LOAM AND SILT LOAM WEST OF CAMARILLO.

The low hills in the distance are occupied by soils of the Rincon and Montezuma series.

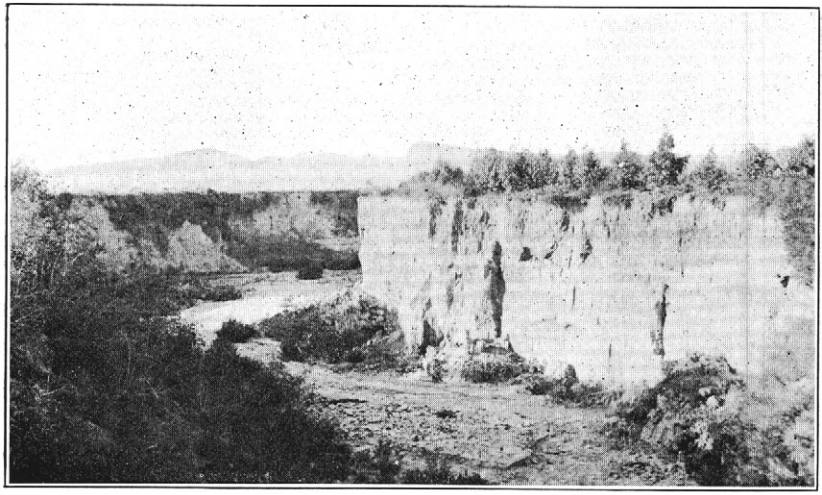

PHOTO FROM UNIV. CALIF.

FIG. 1.—EROSION IN YOLO SILT LOAM NEAR SATICOY.

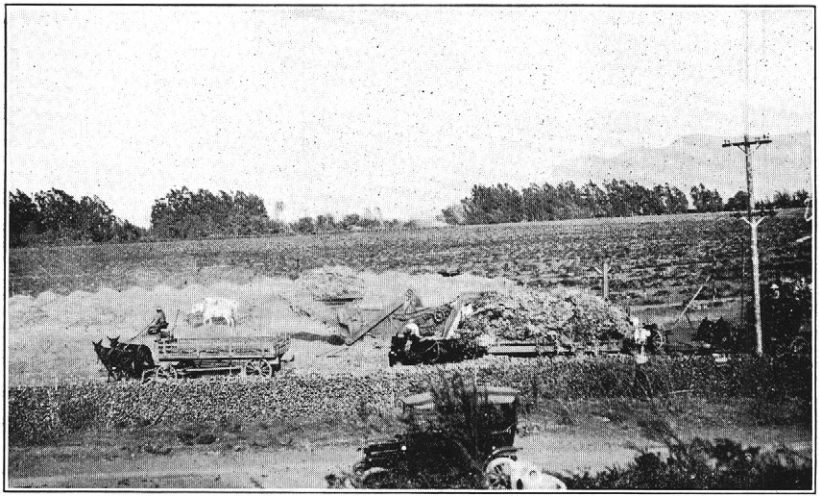

FIG. 2.—THRASHING BEANS ON YOLO SILT LOAM WEST OF SANTA PAULA.

Note stone fence in foreground built of stone removed from the steeper alluvial fans.

alluvial fans. The soil contains a moderate amount of organic matter, is easily tilled, and absorbs and retains moisture well. Dashing rains tend to pack the surface in the areas of heavier texture, which sometimes result in an increase of run-off.

The subsoil is variable. It is most uniform on the larger alluvial fans and in places resembles the surface soil in texture to depths of 6 feet. Over much of the type it is stratified, the various strata differing widely in texture, and near stream courses and on upper parts of fans and foot slopes it sometimes contains varying quantities of gravel and cobblestones. It is lighter in color than the soil. The substratum, i. e., the material below 6 feet, usually resembles the subsoil, but in places is of heavier texture on the more gently sloping plains. The water table is within a few feet of the surface in the lower lying portions of the type. In some of these places the soil has resulted from the deposition of Yolo materials by streams in poorly drained areas.

Those parts of the type along the coast northwest of Ventura include small patches or strips of sandy loam, loam, and gravelly sandy loam. In these and in other bodies along the Ventura and Santa Clara Rivers the variations in texture and stone content are most pronounced. The type in places consists of rather shallow alluvial covering over old valley-filling soils or heavier recent-alluvial types. Some of the lower lying portions in the alluvial plains are subject to reworking by streams and the admixture of fresh material annually. Small bodies of sand and fine sand with spots of loam and silt loam having a calcareous subsoil were also included in areas of this soil at intervals along the ocean, from the mouth of the Santa Clara River to about 3 miles southeast of Hueneme. The accumulation of lime in this phase appears to be due to poor drainage conditions. In other respects it resembles the typical soil.

The Yolo fine sandy loam is the most extensive agricultural type in the area and is widely distributed. It is most important around Oxnard, El Rio, and Camarillo, and on the gently sloping alluvial fans between Ventura and Santa Paula. Other important bodies lie along the Santa Clara and Ventura Rivers and along Arroyo Las Posas, with smaller areas elsewhere.

The type occupies stream bottoms, gently sloping alluvial fans, and nearly level plains formed by coalescing fans. It has a smooth uniform surface, except in a few places where erosion and deposition by small intermittent streams have caused irregularities. Some of the lower lying parts of the type are subject to overflow, and much of it in the Oxnard region has a stagnated subdrainage and contains varying quantities of alkali salts. Elsewhere drainage is good.

The material consists of recent-alluvial material deposited in its present position by spreading streams. It is derived almost entirely from sedimentary rocks and old valley-filling deposits, and much of it is still receiving fresh material annually.

The Yolo fine sandy loam is one of the most important types in the area. It is nearly all under cultivation and is devoted principally to the production of beans, sugar beets, alfalfa, grain, and grain hay. (Plate II, fig. 2.) Extensive planting of lemons, apricots, oranges, and walnuts also occur on the type. The yields are generally high, and the condition of trees and other crops would seem to indicate that the soil is well adapted to many different crops. On those parts of the type affected with alkali yields are lighter and in some places drainage and alkali conditions are so unfavorable as almost to prohibit the growing of most cultivated crops. Walnuts and fruits, except apricots, are regularly irrigated, and one application of water is sometimes given to apricots. Commercial fertilizer is used quite extensively for the citrus fruits, and manure, bean straw, and green cover crops are also rather extensively used, with good results. Land values vary considerably, depending upon location and the condition of the soil. Usually the more desirable parts are held at $250 or more an acre. The poorly drained parts of the type would be very much benefited by lowering the water table below 6 feet.

Organic-matter supply, deep tillage, conservation of moisture, protection from overflow, and drainage are factors to be considered in the best utilization of this type.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Yolo fine sandy loam:

Mechanical analyses of Yolo fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574607	Soil	1.2	7.3	8.1	28.5	29.5	20.1	5.1
574608	Subsoil	.6	7.1	11.4	47.3	21.2	9.4	3.0

The following sample contained more than one-half of 1 per cent calcium carbonate ($CaCO_3$): No. 574607, 0 97 per cent.

YOLO VERY FINE SANDY LOAM.

The soil of the Yolo very fine sandy loam consists of 12 to 36 inches of brown to dark-brown very fine sandy loam, of friable, granular structure, containing moderate quantities of organic matter. The soil is very uniform over most of its extent. The subsoil in the more uniform areas resembles the soil in texture to a depth of 6 feet. Usually it is a lighter brown. In other places it

consists of layers of sand, fine sandy loam, silt, or heavier material. Gravel is rarely present. The substratum in most places resembles the subsoil in color but is commonly of heavier texture. Over the more level parts the water table often lies at depths of less than 6 feet.

The type as mapped includes some small areas of silt loam or fine sandy loam. A variation having a calcareous or marly subsoil is also included. Areas of this character lie along the ocean from the mouth of the Santa Clara River to Mugu Point and in a few other low-lying situations southeast and east of Oxnard. The marly deposits appear to be the result of concentration of lime with other soluble salts on account of deficient drainage. Except for the presence of lime these areas resemble the typical soil.

The Yolo very fine sandy loam is quite extensively developed in the region around Oxnard and south of Leesdale, nearly to Mugu Laguna. Small areas lie along Piru Creek, northwest and east of Ojai, and 2 miles northeast of Somis.

The type occupies gently sloping alluvial fans and alluvial footslopes and occurs along stream bottoms and on nearly level delta plains. The surface is smooth and uniform. The higher lying portions are usually well drained. Much of the type, however, lies rather low and has a high water table, with resulting accumulation of alkali. Some of the lowest areas are subject to overflow by intermittent streams, but only a small amount of reworking of the soil occurs. The material forming the type has been derived from sedimentary rocks and old valley-filling deposits.

Sugar beets, beans, grain and grain hay, walnuts, and some lemons and apricots are produced. The fruits do well only on the better drained parts of the type, and other crops give good yields, except where poor drainage and alkali interfere. The low-lying position of much of the type makes it less well adapted to fruits and nuts generally than the Yolo fine sandy loam. A small part of the type, for the most part poorly drained or affected with alkali, is untilled. The better areas sell for several hundred dollars an acre, and the less desirable ordinarily bring less than $100 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Yolo very fine sandy loam:

Mechanical analyses of Yolo very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574609	Soil	0.2	1.1	1.1	19.7	41.7	28.0	7.9
574610	Subsoil	.5	1.4	1.2	19.6	34.2	30.9	12.1

The following sample contained more than one-half of 1 per cent calcium carbonate ($CaCO_3$): No. 574610, 2.47 per cent.

YOLO LOAM.

The Yolo loam, to a depth of 12 to 30 inches, consists of a brown or dark-brown friable, medium-textured loam. In places the soil is of silty or fine sandy loam texture and does not differ greatly from the Yolo silt loam or Yolo fine sandy loam. The texture tends to grade light rather than heavy. The soil typically contains a moderate proportion of organic matter which aids greatly in moisture-retaining properties and ease of tillage, but in some of the more nearly level parts it compacts with heavy rains. The soil is shallower and more variable near stream courses and on the upper parts of the alluvial fans than elsewhere. Where the soil grades into heavier textured types it tends to bake and become quite hard when dry.

In some included areas the soil contains much gravel, such areas being indicated on the soil map by gravel symbol. In some places large quantities of rock fragments as well as gravel are present. These areas resemble the typical Yolo loam in texture and color, but for the most part they contain less organic matter. Owing to the gravel and stone content, they are more difficult to till, and those parts in which bowlders are most abundant are unsuitable for farming until the stones are removed.

The soil is underlain by the same materials as the other types of the series, and the subsoil in general shows the same color differences and the same variations as in case of the very fine sandy loam or sandy loam. In some of the flatter and lower-lying areas the subsoil is distinctly heavier than the surface material. In such places, and elsewhere where accumulations of alluvial material have taken place at different times, the subsoil may alternate from brown to dark brown in its different layers. The substratum is more variable than the subsoil and consists of beds of gravel or sand along streamways, of dark-colored heavy-textured clay loam or clay in the lowest positions, or, over more uniform areas, of stratified deposits resembling the subsoil.

In the gravelly areas the soil and subsoil tend to be somewhat lighter in texture than typical, and the substratum is usually a light-brown gravelly sandy loam or loose gravel. These areas are inclined to be somewhat droughty on their steeper parts and usually lose much of the rainfall as run-off. The gravel and bowlders are derived mainly from fine-grained sandstone, but come in part from quartzose rocks.

A variation of the type has a calcareous subsoil similar to that of the very fine sandy loam. Areas of this character occupy the lower parts of the type lying on the Oxnard Plains. The concentration of lime, however, is due to a high water table and poor drainage and is not the result of age in weathering, as is the case with the soil derived from old valley-filling materials.

The Yolo loam has an extent of 25.5 square miles and occurs as numerous small bodies throughout the area. The most important areas of typical soil lie along the Ventura and Santa Clara Rivers and the Arroyo Las Posas. The type occurs in the larger valleys of the area and also forms the floors of many of the small drainage ways.

Some fairly extensive areas of the type carrying gravel and stones are scattered over the survey. The largest area, and the most stony, lies on a steeply sloping fan on the north side of the Santa Clara River, about midway between Fillmore and Santa Paula.

The surface is smooth and uniform, except where stream erosion and deposition have modified it slightly. In the many small stream valleys it represents small coalescing alluvial fans of gentle to moderate slope, and such areas have a gently uneven surface. The surface of the gravelly areas is slightly more uneven than that of the nongravelly Yolo loam, but in general the topographic features are similar. It is well drained except in the lower lying areas, in which some alkali occurs. The type is of recent alluvial origin and is composed of material from sedimentary rocks or old valley-filling deposits of the same origin.

Beans, sugar beets, grain and grain hay, walnuts, apricots, and alfalfa are the main crops. Excellent yields are obtained except in the areas of excessive gravel or stone content or in the more poorly drained areas and areas where alkali is present in injurious amounts. Some citrus fruits are grown on the better drained slopes. Irrigation is required for most of the crops except apricots and part of the sugar beets, beans, and grain. The addition of organic matter greatly increases the crop yields. Commercial fertilizer is seldom used, except for citrus fruits. Less desirable parts of the type are used for pasture. The more desirable parts are held at high prices, ordinarily more than $250 an acre. The gravelly areas are usually less desirable than the typical areas and do not sell as readily nor command as high a price.

Conservation of moisture, drainage and reclamation from alkali, addition of organic matter, and deep tillage are leading factors requiring attention for the best returns from the type.

YOLO SILT LOAM.

The surface 12 to 30 inches of typical Yolo silt loam consists of a brown to dark-brown smooth-textured friable silt loam, containing a moderate quantity of organic matter, the proportion being larger in the lower lying and heavier areas of dark color. A relatively large proportion of very fine sand is present in many places, especially in the areas between Ventura and Santa Paula and along the

larger streamways. The silt content is low in places, and the type includes some areas of loam texture. Small quantities of fine gravel and coarse gritty material occur in small narrow areas and patches on the upper parts of alluvial fans and along streamways, and in the latter positions the soil is subject to slight modification or reworking by overflows. In its flatter positions, and where the silt content is highest, beating rains tend to pack the soil, making it less easily penetrated by water and giving it a slickened surface which, if left uncultivated, becomes hard upon drying.

The subsoil resembles the soil in texture and structure in the higher lying and more uniform areas, but elsewhere ordinarily consists of strata of fine sand, silt, and clay, with some gravel along the larger streamways. It shows the same color characteristics and variations as the loam. The subsoil is permeable and retentive of moisture, and where well drained, forms an almost ideal zone for root development. The substratum resembles the subsoil in color and texture, except in poorly drained areas, where it is sometimes heavier and darker in color. It is commonly saturated with water.

A light grayish-brown variation occurs in the east end of Las Posas Valley. This resembles the typical soil in all features except in its lighter color and lower organic-matter content. The color appears to be due to derivation from lighter colored shales relatively low in lime. If more extensively developed, these areas would have been placed in another series. The type also includes small areas of fine sandy loam and very fine sandy loam of the Yolo series, the last being most conspicuous west of Santa Paula, where the content of very fine sand is high. A variation having a calcareous subsoil, occurring in its lowest lying positions, mainly in the regions about Oxnard, Mugu Laguna, and Leesdale, was also included with the type. The high lime content is associated with poor drainage. Except for the accumulation of lime, these areas resemble the other level portions of the type.

The Yolo silt loam is easily tilled, but tends to form a cloddy surface in areas of heaviest textures unless handled when in the proper moisture condition. The application of organic matter and the turning under of cover crops greatly improve its physical properties, increasing its power to hold water and increasing the yields.

The Yolo silt loam is one of the most extensive types in the area and ranks in agricultural importance with the Yolo fine sandy loam. The most extensive areas lie on the valley slopes between Ventura and Santa Paula. Other very important areas occur in the Las Posas Valley, in Simi and Russell Valleys, and along the Arroyo Las Posas and the Santa Clara and Ventura Rivers.

The type has a rather uniform topography and occurs on gently sloping alluvial fans, footslopes, and stream bottoms, and on the ex-

tensive delta plains south and southwest of El Rio. It has a smooth surface, except locally, where erosion and deposition of material by the stream has modified it to some extent. It has a definite type of erosion, and streams crossing it have perpendicular banks often 30 or 40 feet high. (Plate III, fig. 1.) Drainageways are frequently marked by perpendicular drops of 8 or more feet, which slowly work their way up the slope. Drainage is well developed over the higher, more sloping areas, but a high water table and injurious accumulations of alkali are common in the flatter, lower lying parts of the type. In such places a lowering of the water table and the removal of the alkali are necessary for good results in farming. The soil is of recent-alluvial origin and consists of fine sediments deposited in their present position by streams draining areas of sedimentary rock formations and old valley-filling deposits. During periods of high water fresh sediments are added to the soil in many parts of the type.

Nearly all the Yolo silt loam is under cultivation. It is used principally in the production of beans, apricots, lemons, oranges, sugar beets, and walnuts. Grain and grain hay, alfalfa, corn, potatoes, and other crops are also grown successfully. (Plate III, fig. 2.) The type is adapted to a wide range of crops, all of which yield heavily except where poor drainage and alkali interfere. The fruits, excepting apricots, and the nuts are regularly irrigated. Apricots may be given one or two applications of water in unfavorable years or when heavily loaded with fruit. Commercial fertilizer is used liberally for citrus fruits, and barnyard manure is applied whenever obtainable. In many places lima beans have been grown continuously for 20 to 30 years or more, without fertilizer of any kind, and without apparent diminution of yield. The price of land varies with the location, the drainage and alkali conditions, and the character of the improvements. The better parts frequently sell for $500 to $700 or more an acre.

Drainage, the reclamation of alkali-affected areas, deep tillage, and conservation of moisture are important factors in the proper handling of this type.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Yolo silt loam:

Mechanical analyses of Yolo silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574613	Soil	0.4	0.6	0.5	4.9	29.7	47.0	16.9
574614	Subsoil	.2	.4	.3	3.9	29.2	45.6	20.3

YOLO SILTY CLAY LOAM.

The Yolo silty clay loam, to a depth of 12 to 30 inches, consists of a brown to dark-brown silty clay loam, containing a moderate amount of organic matter, the proportion increasing as the color becomes darker. In places the color is much like that of the Dublin clay loam. The texture is somewhat lighter in the more elevated positions, and in the vicinity of the small intermittent streams, the soil here approaching a heavy silt loam or loam. The soil works into a favorable seed bed if tilled at the proper degree of moisture, but if handled when wet, puddles badly, and if plowed when dry, forms a very rough, cloddy surface. In lower lying positions, on the other hand, the soil tends toward a silty clay. The texture is most variable in small areas and in areas occupying narrow stream bottoms.

In the higher lying areas the subsoil resembles the surface soil in texture, but elsewhere it is stratified, being formed of beds of silt loam, fine sandy loam, or clay, with occasional thin seams of gravel or sand. In color the subsoil is like the surface soil or is a lighter shade of brown. In areas on the more elevated valley slopes the subsoil often consists of alternating layers of brown and dark-brown material, the darker colored layers representing former soil surfaces in which organic matter accumulated before being covered with fresh alluvial deposits. These alternating layers often extend to depths of 15 feet or more, but the color fades gradually as the depth increases. The subsoil is permeable to roots and retains moisture well. The substratum resembles the subsoil in color and texture over the better drained portions, but is of heavier texture in the lower lying areas. Both subsoil and substratum are more variable in the small bodies and along drainageways than elsewhere. In places the type has been formed as alluvial fans covering old river terraces, and here both subsoil and substratum may be more compact and contain greater quantities of gravel than typical.

The type includes a calcareous subsoil variation similar to that found in certain other types of the series. Small bodies of lighter or heavier textured types were also included, because of their small extent. A small gravelly area is mapped in the northern part of Russell Valley. It closely resembles other areas of the type in all physical features except gravel content.

The Yolo silty clay loam is of only moderate extent. Areas are located in the northern and northeastern parts of Russell Valley and in the eastern part of Conejo Valley. One body includes the town of Somis, one lies 2 miles south of it, and there are areas of moderate extent northeast of Mugu Laguna and west of Montalvo. Other areas are scattered throughout the area. The areas of clay loam texture lie along the ocean in the southeastern part of the area, and in the Conejo, Las Posas and Santa Ana Valleys; along Santa Paula Creek and Adams, Salt Marsh, and Aliso Canyons, northwest of

Saticoy and east of Fillmore, west and southwest of Simi, southwest of Oxnard, and northwest of Leesdale and Mugu Laguna. These areas are a little more difficult to till than the typical areas and require somewhat more careful handling. In other respects they are similar.

The type occurs on gently sloping alluvial fans, valley slopes, stream terraces, and the nearly level alluvial deltas, and has a smooth, uniform surface. The only surface irregularities occur where small streams spread over the type and either add fresh material or erode gullies through it. The larger drainage ways passing through the type are deeply intrenched and have perpendicular banks. The type has good drainage except in low-lying positions in which a high water table and accumulations of alkali exist. The soil consists of recent sediments laid in their present position by spreading intermittent streams draining areas of sedimentary rock formations and old valley-filling deposits. The type is still in process of formation.

The Yolo silty clay loam is much less important agriculturally than the Yolo silt loam, but it is nearly all under cultivation. It is used in the production of beans, sugar beets, grain and grain hay, alfalfa, apricots, citrus fruits, and walnuts, all of which yield well. Irrigation is commonly practiced in growing nuts and fruits, except apricots. Fertilizers are used for citrus fruits, but rarely for any of the other fruits or crops. The price of land of this type varies according to the location and quality of the soil. It is usually somewhat lower than that of the Yolo silt loam. The type is in need of the same steps for its improvement as the other heavy types of the series.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Yolo silty clay loam:

Mechanical analyses of Yolo silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574615	Soil	0.0	0.1	0.1	2.7	21.9	46.8	28.4
574616	Subsoil	.1	.2	.2	2.1	20.5	50.0	27.0

DUBLIN LOAM.

The color of the Dublin loam typically is dark-gray to black, but in this area the color in many places is dark brownish-gray, the brownish shade being accentuated when the soil is moist. The material is a loam in texture and from 12 to 30 inches deep, grading in places into the subsoil without a distinct line of demarcation. The soil contains a relatively large percentage of organic matter, is rather friable, and is fairly easy to cultivate. It absorbs and retains moisture well.

The subsoil to a depth of 6 feet or more is lighter in color than the surface material, usually having a yellowish or grayish cast. It may be stratified, in which case the various strata may have different colors. The texture also varies somewhat, but usually is a loam, silt loam, or clay loam. The structure is friable. Concentrations of lime exist in the soil and subsoil over much of the type, especially in the low-lying bodies on the Oxnard Plains. The substratum is similar to the subsoil.

The small body of this type found in the lower part of the Santa Rosa Valley is lighter in texture than typical and approaches a fine sandy loam in places.

This is a soil of small extent. Areas are mapped west of Oxnard, near the sand dunes, and east of Oxnard, in the vicinity of Sucrosa. These are all on the large alluvial fan formed by the Santa Clara River. A small area occurs in the lower part of the Santa Rosa Valley. The surface of the type is level and smooth.

The drainage is usually poor, the areas occurring on the Oxnard Plains having a high-water table. Most of the type here is impregnated with alkali salts, which, in places, give it a spotted appearance.

The Dublin loam is a recent-alluvial soil. It occupies the outer or lower portions of the alluvial fans, or very shallow depressions in them, or occurs in the flood plains of streams. It consists of materials washed from the residual soils and older valley-filling types coming mainly from sedimentary rocks. The native vegetation is mostly herbaceous.

Most of the type is used for the growing of sugar beets and grain. North of Sucrosa, where the alkali is confined to the subsoil and where the salts are not sufficiently concentrated to prevent their growth, the land is used in the production of beans. It is naturally a productive soil, and except when the drainage is poor the crop yields are very satisfactory. Ordinarily it is farmed with other lands. The price of land of the Dublin loam type depends mainly on the alkali content and drainage conditions.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Dublin loam:

Mechanical analyses of Dublin loam.

Number.	Description	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574627	Soil	0.1	0.2	0.3	8.1	35.3	39.1	16.8
574628	Subsoil	.2	.2	.3	7.7	31.4	36.2	24.2
574629	Lower subsoil	.8	.7	.5	8.8	27.4	29.8	32.2

The following samples contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$): No. 574627, 1.20 per cent; No. 574628, 2.70 per cent; and No. 574629, 5.34 per cent.

DUBLIN CLAY LOAM.

The color of the Dublin clay loam is dark gray to black, with minor variations of dark brownish gray. When dry, the gray color is most in evidence, but when thoroughly wet, the soil is black. In texture the soil is a clay loam, or in many places a silty clay loam, but the silty clay loam material occurs in such small bodies and grades into the typical soil so imperceptibly that separate mapping was not feasible. The depth of the surface soil varies from 12 to 24 inches. The soil is quite compact and hard when dry, and a slight tendency toward an adobe structure exists locally. A pronounced adobe phase of heavy texture was recognized and differentiated. The soil contains a relatively high percentage of organic matter and is quite retentive of moisture.

The subsoil to a depth of 6 feet is considerably lighter in color than the surface soil, being usually a brownish yellow or yellowish gray, with variations of light brown or medium brown. The texture of the subsoil is a clay loam or silty clay loam, and the structure is quite compact. In places it consists of strata of silt, clay, and occasionally of gravel. Concentrations of lime appear in places, usually where the underdrainage is restricted.

As mapped in this survey, however, the type includes some minor areas of soil which, while resembling the typical Dublin clay loam, differ from this type in origin, and if of greater relative extent and importance, would have been correlated as a member of a distinct series of soils. The subsoil in most cases is of somewhat darker color than that of the typical Dublin clay loam, and the surface soil in many areas has a reddish or chocolate-brown tint. Gravelly areas of the type were mapped in the Upper Ojai Valley and in the small valley south of Conejo Valley. These are indicated on the soil map by gravel symbols.

Areas of the type occur on the Oxnard Plain 1½ miles west of Montalvo, southwest of Oxnard near the ocean, and east of Oxnard near the railroad sidings of Sucrosa and Leesdale. The type is also developed in the Upper Ojai Valley, in the Santa Rosa Valley, in Conejo Valley and the small valleys surrounding it, and elsewhere in the area.

The soil occupies level or basinlike positions and has a smooth surface. Drainage is deficient in most places. East and southwest of Oxnard the soil is so impregnated with alkali salts as greatly to impair its productiveness.

The Dublin clay loam belongs to the recent-alluvial group. It occupies the outer edges of the large alluvial fans formed by the Santa Clara River and occurs in other similar positions elsewhere. The soil was deposited by slowly moving waters and is formed of materials washed from residual and old valley-filling soils, which

come for the most part from sedimentary rocks. In the areas occurring in the Conejo Valley, in the vicinity of Round Mountain, and between Mugu Laguna and Camarillo, it is derived mainly from eruptive rocks of low quartz content. Such areas, however, are not typical. When the soil is well drained and is free from alkali it is very productive. Under present condition, however, the yields are lowered in many places by a high water table and accumulations of alkali. Sugar beets and grain are the main crops. Beans are produced on the better drained areas. Alfalfa is grown to a small extent. Small plantings of pears, apricots, and almonds occur on the type in the Upper Ojai Valley. A small part of the type is still in the virgin state and is devoted to pasture.

Most of the type, except some of the small isolated areas in the eastern part of the survey, is located near shipping points and is well supplied with roads. Prices of land of the type vary widely and depend mainly on the drainage and alkali conditions.

Drainage and the removal of alkali are the matters of most importance in the improvement of the type.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Dublin clay loam:

Mechanical analyses of Dublin clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574634	Soil	2.9	6.6	3.6	18.1	15.2	29.8	23.9
574635	Subsoil	4.4	7.5	3.6	13.2	12.6	30.9	27.5

The following sample contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$): No. 574635, 1.43 per cent.

Dublin clay loam, adobe phase.—The color of the Dublin clay loam, adobe phase, is black with occasional variations of dark gray or dark-brownish gray. It is a clay in texture and varies from 10 to 30 inches in depth. It has a very pronounced adobe structure and is very sticky when wet and bakes hard when dry. It is recognized as properly representing small areas of the clay adobe type of the Dublin series, but separation was not deemed necessary. When properly tilled, the surface soil breaks into small angular granules, forming a fairly good mulch, and if worked when in a favorable moisture condition, the soil can be handled without great difficulty. It retains moisture well and is relatively high in organic matter. It is usually well supplied with lime.

The subsoil to 6 feet deep is a black or yellowish-brown to brownish-gray or dark-brown compact clay or clay loam and is stratified locally. In places it contains streaks having considerable gravel, and layers showing concentrations of lime are sometimes present.

The Dublin clay loam, adobe phase, occurs only in certain small valleys in the eastern part of the survey. Areas are mapped in the eastern end of Conejo Valley, in Russell Valley, in Lindero Canyon northeast of Russell Valley, and in the Tierra Rejada Valley and the hills south of it. Parts of the soil in Russell Valley are gravelly.

The topography is gently sloping to nearly level, and the surface is smooth. Surface drainage depends upon the slope, being inadequate over the more nearly level areas. Subdrainage is quite poor on account of the heavy texture of the soil, subsoil, and substratum. Alkali does not occur in injurious quantities except in a very small area southeast of Round Mountain.

The Dublin clay loam, adobe phase, is of recent-alluvial origin, but in this survey some of it has lain in its present position until subsoil changes have taken place, giving such portions a slight resemblance to old valley-filling types. The material has come mainly from sedimentary rocks, but basic igneous rocks have supplied some of the materials, and the areas in the Tierra Rejada Valley and vicinity, and in the locality southeast of Round Mountain, consist of material derived mainly from such rocks. The lime content in both soil and subsoil in these areas appears to be less than in the typical areas formed of wash from sedimentary rocks.

The phase is considered by farmers to be better suited to dry-farmed grain than to other crops, and yields depend largely on the rainfall. They are good if rains come in late spring, and under favorable circumstances as much as 4 tons of grain hay has been obtained per acre, while under unfavorable conditions yields drop to 1 ton per acre or less. A few beans are grown, but yields are frequently light, owing to difficulty in obtaining a stand. Some apricots are also grown, and a small acreage is devoted to pasture. Land of this phase is less valuable for agriculture than the land of lighter textured alluvial soil.

In managing this soil the most important factors to be considered are proper selection of crops, tillage at the right time, and conservation of moisture.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Dublin clay loam, adobe phase:

Mechanical analyses of Dublin clay loam, adobe phase.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574670	Soil	0.2	0.9	0.8	4.5	12.0	31.5	49.6
574671	Subsoil	.7	2.9	2.7	12.1	19.5	26.3	35.5

The following sample contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$): No. 574671, 2.11 per cent.

VINA FINE SANDY LOAM.

The Vina fine sandy loam is a brown to dark-brown friable fine sandy loam, often having a reddish shade, especially in freshly plowed fields. The soil is from 12 to 24 inches deep. It contains a moderate quantity of organic matter. It absorbs moisture rather slowly, but retains it fairly well. Scattered gravel and cobblestones are present in the soil in places, but not in sufficient quantities to affect tillage.

The subsoil to a depth of 6 feet or more is a little lighter in color than the surface soil, being light brown, brown, or in some cases dark brown. Its texture is typically fine sandy loam or loam, but in places the material is stratified, and in this case both color and texture vary, the color being various shades of brown and the texture a sandy loam, silt loam, or clay loam, with more or less gravel. The subsoil for the most part is moderately friable, but it may be compact. The substratum has the same general characteristics as the subsoil. The chemical reaction of the soil and subsoil is neutral or alkaline, but no concentrations of lime are apparent.

The Vina fine sandy loam as mapped in the Conejo Valley is variable in texture, some of it being a sandy loam, and some of it a clay loam, but these variations are in such small bodies that it is not practicable to show them on the map. The central part of the large body located in Russell Valley and a small area just east of Round Mountain are silt loam in texture. Otherwise, these variations conform to the type as described.

The type is developed in the small valleys southeast of the center of the area. It occupies most of Potrero Valley and some very small narrow valleys near it. Other areas occur in Russell Valley, Conejo Valley, in the small narrow valleys of the Santa Monica Mountains, and elsewhere in the survey.

Erosion is active in only a few places on the upper parts of the alluvial fans. Most of the type has good surface drainage and fair to good subdrainage, and is almost free from alkali, except for small bodies near Round Mountain which carry an excess. It is not subject to overflow.

The Vina fine sandy loam is a recent-alluvial type occupying small fans and stream bottoms. It has been deposited by intermittent streams and is formed of materials coming almost entirely from basic igneous rocks.

Beans, grain, and alfalfa are the main crops grown on this soil, and the yields of all are very satisfactory. Sugar beets, walnuts, and other crops are also grown to a small extent. The small part uncultivated supports a scattered growth of oak and brush and is used for pasture. This is a very productive soil. It lies at consider-

able distances from markets, but is served by good roads. Settlement is not extensive, because the land is held in large tracts. The productive value of the land compares very favorably with that of the more extensive Yolo loam.

Conservation of moisture, increase of organic matter, and proper rotations are the main things to consider in improving and utilizing the type.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Vina fine sandy loam:

Mechanical analyses of Vina fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
574632	Soil	3.2	7.2	4.4	20.0	20.9	30.4	13.5
574633	Subsoil	4.1	9.3	5.6	23.8	15.2	21.2	20.5

RIVERWASH.

Practically all of the streams in the area are intermittent, and after the rainy season their channels are dry and barren of vegetation except for small stands of sweet clover and willow over the least exposed parts. These stream beds are mapped as Riverwash. The material varies greatly in character and ranges from large bowlders and cobblestones to smaller gravel and sand. The material is gray or light grayish-brown in color, and loose, porous, and leachy. Sand and fine sand predominate in the Ventura River bottoms and form the bed of the Santa Clara River throughout its entire course in the area, while stony material prevails almost entirely along the channels of Santa Paula, Sespe, and Piru Creeks. A number of small low islands along the river beds, each covering a few acres, are included in Riverwash as mapped in this survey. These are tillable; the rest of the type is nonagricultural.

ROUGH BROKEN AND STONY LAND.

Rough broken and stony land, as recognized in this survey, consists of two types of nonagricultural material, viz, Rough broken land and Rough stony land. The general occurrence and extent of the latter is indicated upon the soil map by rock outcrop symbols.

Rough broken land consists of rolling, hilly, mountains, and badly dissected areas too uneven and irregular for agriculture. Some rock outcrop may occur locally over areas of residual soils, but it is small in extent. Rough broken land often covers the lower slopes of the mountains, but is extensively developed in areas of severely dissected old valley-filling material. Less extensive areas occur in residual

soil areas derived from both sedimentary and basic igneous rocks. In areas from the latter the soils are usually shallow and droughty and of little value for pasture. Land slides are very numerous in the area of Rough broken and stony land. The slides vary in extent from less than an acre to 20 or more acres, and are often so close together that almost the entire surface of one or more square miles in places appears to be a continuous mass of slides. They occur most frequently in winters of heavy rainfall and almost entirely where the strata are upturned at a high angle. The soil material varies in color and usually ranges from brown to dark-gray. It varies in depth from a few inches in areas of igneous rocks to many feet where sedimentary rocks and old valley-filling deposits occur. In texture it is mainly a loam or clay loam, but small bodies of lighter or heavier texture are also present.

Rough stony land consists of areas which are not only too rough and steep, but too stony for agricultural purposes. Its stony character and large area of rock outcrop are the main features which distinguish it from Rough broken land. The material in this survey includes very steep, rugged, mountainous areas with small detached bodies of more subdued topography. The soils are very shallow, and in many places bare rock and rocky, clifflike escarpment faces prevail. Loose surface rock is abundant, and on the more moderate slopes the material gradually merges into soils of the Olympic and Altamont series. In areas of basic igneous rocks, and where lime is abundant in the sedimentary rocks, the soil covering usually ranges from brown to dark grayish brown in color, with a pronounced adobe structure in many places. Elsewhere the color ranges from light grayish brown to brown. The soil covering is shallow, usually being deepest in areas of sedimentary rocks. It is droughty, soon loosing its moisture after the winter rains cease. The type is excessively drained, and the soil material is removed by erosion in many places almost as rapidly as formed.

Rough broken and stony land is very extensive in this survey. It covers a large area along the northern boundary of the survey and is prominently developed north, northwest, and northeast of Ventura and in the hilly and mountainous areas along both sides of the Santa Clara River. It also covers extensive areas north and northwest of Simi Valley and in the Simi Hills. Other prominent areas occur in the mountains and hills surrounding Conejo Valley and in the Santa Monica Mountains in the southern part of the survey.

The type is utilized almost entirely for grazing. A few isolated tracts of a few acres each, which are capable of cultivation but relatively inaccessible, are included. Its value as pasture land varies considerably but is usually greatest in areas of sedimentary rocks, where the soil is deeper and less brush occurs than where igneous rocks prevail.

COASTAL BEACH AND DUNESAND.

Coastal beach and dunesand includes two classes of deposits very similar in character of material but different in topographic position and manner of deposition. The Coastal beach soil consists of gray or light grayish brown sand lying along the ocean, toward which it slopes gently. The dunesand consists of the same material, but has been piled up by the wind and has a rolling surface. The beach is very narrow and rarely exceeds one-eighth of a mile in its widest parts. It is subject in part to reworking by the tides, and both Coastal beach and dunesand are subject to modification by wind action. Some fine gravel and many marine shells are present in places in the beach. As a rule, the material forming the dunes contains greater proportions of fine sand and silt than the Coastal beach. Both are low in organic matter and nonretentive of water.

Coastal beach and dunesand occupies a narrow strip along the ocean front from Mugu Point to a point a short distance beyond Ventura. Other small narrow strips occur along the ocean front along the south side of the Santa Monica Mountains. It usually occupies a higher position than Tidal marsh and serves as a low barrier between the areas of the latter and the ocean, though its highest parts are seldom more than a few feet above high tide, and the dunes rarely exceed 20 feet in height.

The type is practically nonagricultural and supports no vegetation except a little scrubby brush in places.

TIDAL MARSH.

Tidal marsh consists for the most part of a dark grayish brown or dark-brown clay loam or silty clay loam, though a few areas have a loam or fine sandy loam texture. The surface few inches of soil is somewhat lighter in color than the subsoil, which consists of a dark-gray clay loam or clay, in many places of a bluish shade. In places where streams are active the subsoil is stratified. Where it has been partially drained and reclaimed the soil tends to become browner and the cross section approaches that of the heavy upland types. Concentrations of lime are evident in places in the subsoil, and small calcareous nodules may occur. An overwash of alluvial material, varying in depth from a few inches to several feet, occurs along the inland side of the type, and yearly accretions of alluvial material deposited by flood waters are slowly restricting its area. Both soil and subsoil are in poor physical condition, owing to their waterlogged condition, high alkali content, and poor aeration.

The type occurs as a narrow interrupted belt extending from Mugu Point northwestward along the coast beyond Hueneme, with one small body within the city limits of Ventura. It is usually separated from

the ocean by a narrow body of Coastal beach and dunesand with occasional openings through which the tidal channels pass.

Tidal marsh occupies the lowest topographic positions in the survey, and much of it is subject to inundation at each high tide. The surface is usually flat or basinlike and marked by winding tidal sloughs. During flood tide the sloughs which serve as drainage outlets for part of the region to the north are filled with water. The soil material has been deposited by inland streams and redistributed by tidal currents, and the type is still receiving fresh additions each year. Some wind-deposited sand has been spread along the side nearest the ocean. The boundary between Tidal marsh and the adjacent alluvial soils is not distinct in places, owing to the gradual thinning out of alluvial deposits which are superimposed over the Tidal marsh about its margin.

Under present conditions Tidal marsh has practically no agricultural value, owing to its salt content and periodical inundation.

Very little attempt to drain this land has been made, but in a few cases areas have been successfully reclaimed. It supports a heavy growth of "pickle weed," some salt grass, and other alkali vegetation. Pasture is its main use.

IRRIGATION.

The seasonal distribution of rainfall in Ventura County, like that of other parts of the coast region of southern California, is such as to make irrigation necessary for the greatest returns from certain crops. This is especially true for citrus fruits, walnuts, and alfalfa, where a succession of crops is grown on the land in one year, or where soil and subsoil do not retain moisture well. The soils of the Ventura area, however, require less frequent and copious irrigation than those farther inland, owing to frequent spring and summer fogs and a relatively high humidity of the air. For these reasons the moisture requirements of the soils increase with the distance inland and are largest in those parts of the area shut off from the influence of the ocean. Irrigation is not an absolute necessity for any of the crops excepting the citrus fruits, but during years of low rainfall it supplements the natural moisture supply, increasing yields and insuring the maturity of many of the crops at the proper time.

Irrigation is not extensively practiced in the area and is confined principally to the Santa Clara River Valley, a small part of the plains north of Oxnard, the lower part of the valley along the Ventura River, part of the Ojai, Santa Ana, and Simi Valleys, a small acreage in Russell Valley, and part of the lands along Santa Paula, Sespe, and Piru Creeks. A few other scattered localities have developed minor supplies of water for irrigation, but the total acreage covered in these projects amounts to only a few square miles.

The main sources of water supply by gravity are the Ventura and Santa Clara Rivers and Santa Paula, Sespe, and Piru Creeks. In addition to this, about 10,000 acres or more are irrigated by pumping from wells located in the several valleys and in the plains portions of the area. Water is also obtained from artesian sources in the district lying between Saticoy and the foothills of the Santa Monica Mountains on the southeast and small supplies from storage reservoirs in Russell Valley and a few other localities. The supply of water for irrigation is ample for the present needs of the area, and if necessary could be greatly augmented by storing the flood waters of winter and by extending the development of the underground supply. Water for pumping is most abundant near the coast and usually diminishes in quantity farther inland.

Water is conveyed to farms by open ditches and underground pipe lines. The latter method is preferred on account of diminished losses by seepage and evaporation. According to the United States Department of Agriculture[1] it is estimated that losses from seepage through canals in the area range from 5 to 30 per cent. The same publication gives the duty of water from canals in the Santa Clara River Valley as ranging from 0.46 acre-foot per acre for beans to 6.21 acre-feet per acre for alfalfa, with an average duty of 2.74 and 2.48 acre-feet per acre for lemons and oranges, respectively. The average duty of water under pumping plants was found to be about 0.55 acre-foot per acre, and the depth of wells ranges from 100 to 500 feet.

Fruits and beans are irrigated by the furrow method, and the check system or movable pipe-line method is used for alfalfa. The uniform, deep alluvial soils absorb and retain moisture best and require less water than those with porous stratified subsoils. Types with heavy subsoils are usually slow to absorb water, but when the subsoils are once wet they retain mosture well. The length of the irrigating season and the number of applications given crops varies somewhat and depends largely upon the amount and distribution of rainfall and the distance from the coast. Citrus fruits receive water once in every four to six weeks from about May to October or November, inclusive. Alfalfa is irrigated one or two times for each cutting, depending upon the soil and location. Apricots and walnuts receive about two applications during the season, and beans usually one where irrigated. The cost of water varies and depends upon distance from the source of supply, and, in the case of pumped water, depth of wells. It is usually cheaper under the gravity systems. Most of the water is supplied to users by companies from the gravity systems, the users generally being stockholders and sharing proportionally in the costs. Some companies operate wells in a

[1] Bul. 254, U. S. Dept. Agr., Irrigation Resources of California and their Utilization.

similar manner, and in many instances each individual farmer has his own well.

Irrigation is gradually being extended in the area, and if the demand for water continues to increase, measures for storing may become necessary.

ALKALI.

The alkali-affected portions of the Ventura area are associated with deficient drainage and a high water table and are outlined on the soil map by red lines. Owing to the relatively rapid changes in concentration of the salts present, to their irregular and variable distribution in the soil and subsoil, and to lack of reliable surface indications, only two field separations were made. The soil areas having salt concentrations sufficiently high to prevent the growing of crops until the soils are reclaimed are shown on the map by the symbol "A", and those containing less concentrated but variable amounts of salts either in the surface soil or subsoil, and sometimes possessing a spotted surface, with intermingled good or poor crops and barren spots, are indicated by the symbol "S." The latter classification also includes areas with moderate to high concentrations of alkali salts occurring in the soil profile from the third foot downward with no surface accumulations and no apparent injury to such sensitive crops as beans. The type of soil and texture of subsoil have much to do with the position of the salts in the soil cross section and their injury to crop. Wherever the soil is a loam or lighter in texture and is underlain by lighter textured subsoils, the alkali is usually concentrated near the surface and diminishes in quantity as the depth increases. The reverse is usually true where the subsoils are heavier textured than the surface soils, and in the latter case excellent yields of shallow-rooted annuals are often obtained with relatively high concentrations of salts below depths of $2\frac{1}{2}$ feet.

The greatest concentrations of alkali occur in low-lying areas with poor drainage, and the total salts present usually increase as the ocean is approached. The most extensive bodies of alkali-affected soils are located on the Oxnard Plains southwest, southeast, and east of Oxnard. About 2 square miles are also mapped in the western part of Simi Valley, small bodies within the limits of Saticoy and Ventura, and one southwest of Montalvo. Minor surface accumulations of alkali salts also occur locally along the lowlands bordering the Santa Clara River, but they are not sufficiently concentrated to map.

Sodium sulphate is the principal alkali salt present in the areas indicated by the symbol "S"; while sodium chloride prevails in the areas of greater concentration. No black alkali was found in the field tests made. Sodium chloride appears to be the most injurious

salt present in quantity, and its occurrence is due mainly to the evaporation of sea water in the low Tidal marsh areas in or near which the areas of heaviest concentration are most abundant.

A comparative study of about 4,000 acres of alkali land lying west of Oxnard which was mapped in a previous soil survey 1901,[1] reexamined in 1910, and again during the present survey, indicates a general decrease in the salts present from the period of the first to the last mapping. The general decrease in salt content appears to be largely due to the fact that the tract has been tile-drained. The percentage of salts found in the three surveys varies greatly, owing evidently to the local variations in salt concentrations in the locations where the tests were made, drainage, and, possibly, to the movement of salts during the interim.

The general extent of the alkali areas at the present time agrees quite closely with that of 1901, with the exceptions of a small body one-half mile south, one nearly a mile east, one just west and north of Oxnard, and one near El Rio, which were not encountered in the earlier surveys. Several of the other former alkali boundaries have also been extended slightly in this survey. The salt concentrations do not appear to vary much, but the affected areas seem to be spreading in certain places where the water table is near the surface.

The alkali has not in this case resulted from overirrigation, because water is rarely applied to crops in this part of the survey or on the higher-lying hands to the north. It has accumulated from a naturally high water table due to drainage and seepage from the Santa Clara River, Arroyo Las Posas, and small creeks which empty on the plains.

The toxic effect of the salts depends largely upon their position in the soil column, texture of soil, tillage methods, weather conditions, and the crops grown. Many annuals thrive with high concentrations below 2½ feet, while they often show marked ill effects with considerably lower concentrations near the surface. Perennials are rarely grown where the subsoils are strongly impregnated with alkali, even though the surface material is free from injurious concentrations. Nearly all of the areas indicated by the symbol "S" are intensively farmed to sugar beets, beans, and barley, and in many places the presence of alkali would never be suspected from the appearance of the growing crops. In some places spotted fields may be due to a high water table with low salt concentrations, and in others the poor stand may be almost entirely due to alkali. Sugar beets vary considerably in their resistance to alkali. Good crops were found growing on heavy soils with an average of more than 1 per cent of alkali in the surface 6 feet, while in other places the

[1] See Soil Survey of the Ventura Area, California, Field Operations, Bureau of Soils, U. S. Department of Agriculture, 1901.

crops were spotted, patchy, and yellowish with one-fifth that content of alkali. Barley has about the same resistance as sugar beets. Beans are much more sensitive and usually show a yellowing or spotted appearance with 0.2 per cent of alkali in the surface 2 feet; while on the other hand, they yield heavy crops with an average concentration of 0.35 per cent for the surface 6 feet, providing less than 0.2 per cent is in the surface 2½ feet. Alfalfa does moderately well for a few years under similar conditions. It is customary to plant sugar beets on badly affected alkali land early in spring, in order that germination and an early growth may occur before the alkali rises to the surface. In favorable years this practice is very successful, but if the spring is cold and backward many of the beets go to seed and require extra labor to remove the seed tops.

Most of the soils containing alkali are of medium to light texture and not difficult to reclaim. The slope of the lands affected, however, is slight, and pumping from sump holes is sometimes necessary to remove the drainage waters. In some instances a lowering of the water table would suffice, and the excess salts could be removed by the natural rainfall, but in others tiling and surface flooding appear necessary to secure results within a reasonable time. Underdrainage and flooding, with good tillage to reduce evaporation, should result in greatly improved conditions without great cost. The most feasible way to handle the problem is by cooperation among farmers, in order to secure outlets and to reduce the cost. The low-lying tidal lands mapped (A) will be much more costly and difficult to reclaim on account of their heavier textured soils, higher salt content, and saturation by tidal waters. They will not likely receive much attention until the demand for additional farming land becomes great enough to warrant the cost of their reclamation.

SUMMARY.

The Ventura Area lies along the Pacific coast in the southwestern part of California. It comprises the southern half of Ventura County and a small part of Los Angeles County, covering an area of about 1,200 square miles, or 768,000 acres. It includes nearly all of the agricultural land of Ventura County.

Its surface features vary greatly and include many narrow valleys and broad alluvial deltas with numerous hilly and mountainous elevations ranging from sea level to about 6,300 feet. The greater part of the Santa Monica Mountains, with Oak Ridge, South, and Sulphur Mountains, and numerous other sharply dissected hilly areas constitute the main elevations occurring within the area. The Ojai, Upper Ojai, and Santa Ana Valleys occupy basinlike depressions in the northwestern part. The great delta of the Santa Clara River forming the Oxnard Plain is the largest area of nearly level smooth

surface, and with the Santa Clara, Conejo, Las Posas, Simi, and Russell Valleys, and several others of very small extent, form the areas of uniform land surfaces. Numerous landslides mark the slopes of the hilly portions where sedimentary rocks or old valley-filling deposits are present.

The general slope of the area is southwest to the Pacific Ocean, and the gradient is usually ample for the removal of flood waters, except along the major streamways and over part of the Oxnard Plain. The Santa Clara and Ventura Rivers with Arroyo Las Posas, Santa Paula, Sespe, and Piru Creeks are the main drainageways.

Ventura is the county seat and largest city of the area. Oxnard, Santa Paula, Fillmore, Ojai, Somis, Moorpark, Piru, and Saticoy are other prosperous cities and towns. A number of smaller villages and railroad stations are scattered over the area. Seventy per cent of the population is rural.

The Southern Pacific Railroad "Coast Line," with branches connecting Ventura with Saugus and Ojai, forms the chief means of transportation outlet. A completed portion of the State highway extends through the area, and a number of important county highways connects it with various parts of the area.

The climate is mild and includes a wet and a dry season corresponding with winter and summer, respectively. Fogs are frequent in the winter, spring, and summer months, and the humidity is generally high along the coast. The rainfall varies in different parts of the area, but averages a little over 15 inches. Snow does not fall in the valleys but occurs on the higher mountains in winter. Hail and thunderstorms are very rare. Mean temperatures also vary considerably in different parts of the area. They are lowest along the coast and rise as the distance inland increases. Hardy vegetables can be grown in the winter months. Wind velocities are high along the coast and in the open valleys in spring and early summer, and some damage is done to young crops on the light-textured soils where not protected. The prevailing winds are from the west and southwest.

Most of the agricultural development has taken place in the last 50 years. Wheat, barley, corn, and flax were the earliest crops grown, and cattle and sheep raising were important industries. This type of agriculture has been largely displaced by more intensive systems of farming, and beans, sugar beets, barley, walnuts, apricots, lemons, and oranges are the principal crops now grown. Some alfalfa and potatoes are produced.

Poultry, hogs, bees, dairying, and cattle raising are more or less important industries. The agricultural practice is of the most modern type.

The important soils of the area are divided into three groups—(*a*) residual soils, (*b*) old valley-filling soils, and (*c*) recent-alluvial soils. In addition to these, four miscellaneous types, mainly nonagricultural, Riverwash, Rough broken and stony land, Coastal beach and dunesand, and Tidal marsh, are mapped.

The residual soils occur in the hilly and mountainous parts of the area and are formed from the weathering of rocks in place. Those derived from sedimentary shales, sandstones, and conglomerates were included in the Altamont and Diablo series, and those derived from basic igneous rocks in the Olympic series. There are seven soils of these three series shown on the map.

Old valley-filling and coastal-plain soils are old, unconsolidated, waterlaid deposits which have undergone marked change in their subsoil and topographic features since their deposition. The soils in this group were mapped in five series—the Rincon, Pleasanton, Ojai, Madera, and Montezuma. The map shows the location of six types belonging in this group.

The recent-alluvial soils are the most extensive soils in the area, and portions are still receiving fresh alluvial accumulations annually. They occur on alluvial fans, alluvial valley slopes, stream deltas, and along stream bottoms. Three series—the Yolo and the Dublin series, formed of wash from sedimentary rocks, and the Vina series, consisting of materials transported from areas of basic igneous rocks—were recognized in this group. Twelve types in these series occur in the area surveyed.

Riverwash consists of material occupying nonagricultural stream bottoms and in character varies from sand to gravel and cobble.

Rough broken and stony land is rough, rolling, hilly, or mountainous land, frequently with stone and rock outcrop, and too rough and steep or too stony to till. It is used for pasture.

Coastal beach and dunesand comprises a small margin of beach sand with an accompanying narrow belt of low sand dunes along the ocean front.

Tidal marsh consists of low, flat, salty areas either wholly or partially inundated by high tide, and is nonagricultural.

The soils of old valley-filling and recent-alluvial groups include the most important agricultural lands of the area.

Irrigation is not absolutely necessary for the production of crops in the area except citrus fruits. It materially aids, however, in increasing crop yields, in maintaining the vigor of trees, and increasing the size and quality of fruits and nuts. The supply of water necessary for the best returns increases with distance from the coast. Irrigation is practiced in parts of all the valleys. Water is obtained from streams, by pumping from underground sources, and from

small reservoirs and artesian wells. The water available is ample for the present needs, but any considerable extension of the irrigated area will necessitate the storage of flood waters and further development of underground supplies.

Alkali is present in the soil over much of the Oxnard Plain and also occurs in the west end of Simi Valley, in small bodies in the towns of Saticoy and Ventura, and in the region southwest of Montalvo. It is always associated with a high-water table and varies in concentration from mere traces to quantities greater than 1 per cent for the surface 6 feet. Sulphate of sodium predominates in the more inland areas, and sodium chloride prevails near the seacoast. Black alkali apparently is not present. Drainage to lower the water table and surface flooding to wash out the alkali are necessary in reclaiming land containing the larger concentrations of alkali. Elsewhere drainage alone will suffice.

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[PUBLIC RESOLUTION—No. 9.]

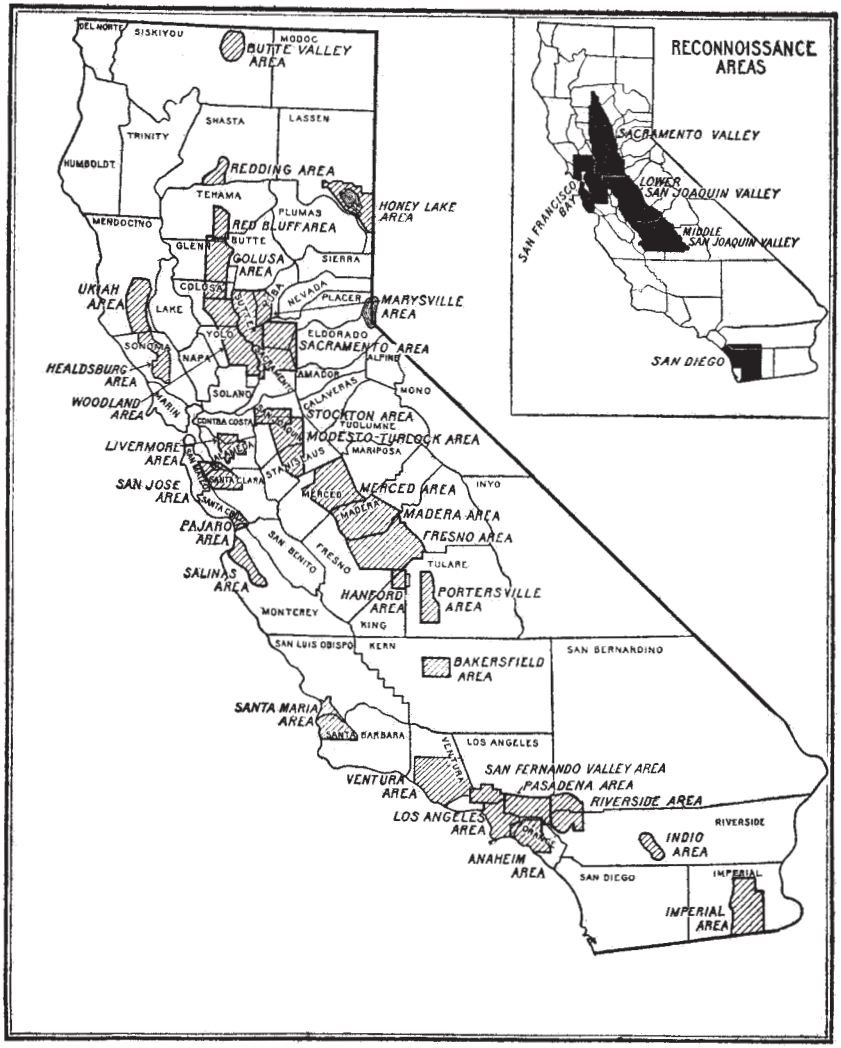
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in California.

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U.S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP
CALIFORNIA
VENTURA SHEET

UNIVERSITY OF CALIFORNIA
AGRICULTURAL EXPERIMENT STATION
THOMAS F. HUNT, DIRECTOR.
CHARLES F. SHAW, IN CHARGE SOIL SURVEY

Macy H. Lapham, Inspector Western Division.
Soils surveyed by J. W. Nelson, in charge,
and Walter C. Dean, of the University of
California, and A. E. Kocher, E. B. Watson, and
E. J. Carpenter, of the U.S. Department of Agriculture.

BASE MAP FROM
U.S. GEOLOGICAL SURVEY SHEETS

Field Operations
Bureau of Soils
1917